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ABSTRACT

This guide outlines the basic skills and knowledge necessary for entry-level competencies in the field of building construction, or for entrance into a post-high school or university program. The introductory section includes (1) brief job descriptions from the "Dictionary of Occupational Titles" for the seven key occupations represented in the construction cluster--carpenter, trowel trades, iron worker, pipe trades, floor layer, painter, and roofer, (2) Oregon manpower data, (3) a task analysis for determining course content, (4) an instructional analysis for organizing learning experiences, (5) a suggested list of allied elective courses, and (6) a suggested construction cluster curriculum. Instructional specifications constitute the major portion of this guide and are organized in the following areas, which are discussed in separate sections: Communications, layout, cutting and fitting, fastening and assembly, construction materials, finishing, and safety. Each of the sections includes statements of required knowledge, expected behaviors (skills) upon completion of the section, suggested learning activities, and an annotated list of instructional materials (print and nonprint). Appendix A (51 pages) presents guidelines for an accident prevention program for school shops and laboratories. Appendix B is a prioritized list of minor tools and equipment and appendix C is a four-page directory of media producers and distributors. (SH)

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CURRICULUM GUIDE FOR BUILDING CONSTRUCTION

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CE 011 908

PREFACE

Preparation for Career Entry

THE OREGON WAY

Oregon is embarking on a new approach to secondary education that will affect general as well as vocational programs. We are calling this new approach "The Oregon Way" and it is based upon two assumptions:

(1) Secondary schools should be preparatory institutions for *all* students, not just those headed for college. (For years we have been telling students, "If you want to go to college, you must do this, and this, and this.") We need to do the same thing for students who are not going to be able to attend a four-year college.

(2) A "preparatory" program ties the curriculum to the lives of students in such a way that they are better equipped to choose their future goals and better equipped to take the next step (different for every student) in each of several concurrent "careers" they will need to pursue upon leaving high school.

The career cluster program will require five major changes in our school systems:

(1) *High schools must make a definite commitment to move to career cluster tracks from the present tracking system which uses such terms as "advanced-college prep," "terminal-general," or "remedial-basic."* Rather than relating his program to a college prep or terminal track, the high school student would relate most of his high school experiences to one of the eighteen career cluster tracks. The long and short of it is that we would replace the present counseling and student program emphasis on academic ability with emphasis upon real life goals.

(2) *It will be necessary to give "general education" a massive infusion of illustrations from the world of work.* The vast majority of students in our schools need to have academic subject matter related to what concerns them in real life. Teachers at all levels must plow up their subject area fields and "sow" them with relevant materials. They must bring into the teaching process examples of how the concepts and symbols and language of their particular disciplines can be used in everyday life, and more particularly in a career.

(3) *High school curriculums will need to be rebuilt around the career cluster or family of occupations concept,* so that students may select a career cluster at the beginning of their high school experience and then tie a majority of their high school experiences into this cluster. This will not involve so much a change in facilities or curriculum as it will a change in guidance and counseling patterns and a change in the way a curriculum is outlined. What we are really calling for here is a change in thinking so that preparation for a career becomes accepted as one of the clear and primary objectives of the secondary school.

(4) *Specific training for those thousands of occupations that do not require a bachelor's degree for job entry should be the responsibility of community colleges, apprenticeship programs, on-the-job training, or proprietary schools.* If the student goes through a good career cluster program in high school, he should be prepared for an entry-level job, but more likely, he will be prepared for specialized post-secondary education and training. We are urging community colleges and high schools to cooperate in planning an articulated educational program that will enable all students to achieve their career

goals. Community colleges and high schools should cooperate in the planning of joint use of facilities, guidance and counseling programs, advance placement opportunities, and, when feasible, instructional staff.

(5) *Every school and community college must build highly integrated and greatly strengthened guidance and counseling programs.* Elementary school guidance must be slanted toward spotting problems in developing approaches and solutions to the problems of primary grade children—toward prevention rather than remedial action later on. Secondary guidance and counseling should be oriented toward helping students set goals and life-styles. Heavy emphasis must be placed on services for the normal student, rather than limiting services to those required by the problem students. At present, guidance and counseling in many public schools is a fire-fighting operation, rather than a service which reaches the majority of students who do not have highly deviant behavior patterns.

Students at the high school level should not be expected to set specific goals, rather they should choose a broad field of interest, and the guidance and counseling process should be so structured that if a student wants to change even the broad area in which he is studying, he can do so with a minimum amount of frustration.

We have made at least seven *specific assumptions* concerning the actual development of career cluster curriculums at the senior high school level.

(1) Occupational skill classes require a minimum enrollment of 15-18 students in order to be operationally efficient and economical.

(2) Selection of a broad career goal will take place at approximately the end of the eighth grade or beginning of the ninth grade for all students. Student schedules will differ even within career goals due to differing desires and abilities.

(3) Eighteen clusters or families of occupations can be developed that will offer the necessary minimum skills and knowledge for further training or minimal entry employment. A minimal program of occupational education for any high school should consist of at least *seven* of the clusters.

(4) Most *specific* career education courses and labs are identified for the 11th and 12th grades, requiring a minimum of 10 hours per week to provide intensive and extensive instruction necessary for any effective entry occupational performance, and of course this is in addition to regular state or local general education requirements. However, it is urged that even the general educational experiences be related to the career cluster goal.

(5) A well-developed guidance and counseling program, particularly for the middle grades 7-8-9, is essential to the success of this program.

(6) Exploratory experiences will be provided in the middle grades, allowing students to develop a basic understanding of the various families of careers.

(7) Basic to all of this is solid student performance in the fundamental skills of communication and computation.

(8) Supervised work experience is a vital part of the cluster curriculums.

DR. DALE PARNELL
Superintendent of
Public Instruction

ACKNOWLEDGMENTS

Industry and education have worked together over the past few years to develop this guide. Industrial representatives, special consultants, secondary school administrators, and teachers participated in analysis studies, committee work sessions, and individual reviews of all phases of its development.

The final draft was assembled and coordinated under the direction of James W. Hargis and Ralph Little, Specialists, Division of Community Colleges and Career Education, Oregon Board of Education.

Special recognition is given to Sterling Borquist of Portland's Benson High School for his major contribution in the developing phases of analyses in this guide.

Mr. Harold J. Arendt, Jr., Director of Educational Media, Benson Polytechnic School, Portland, Oregon, compiled the lists of educational media found at the end of each instructional unit.

Grateful recognition is also given to the members of the advisory committee. Their contributions were invaluable.

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INTRODUCTION

If high schools are going to meet the needs of all students, educational programs, especially for grades 11 and 12, must include opportunities for students to develop entry-level skills for a broad "family" of occupations so that they have several options for employment when they leave high school.

Believing this, the Oregon Board of Education staff has analyzed the basic elements of hundreds of jobs with similar characteristics and grouped them into occupational clusters with similar entry-level requirements. From the resulting list of job clusters, the staff, in cooperation with the Division of Employment and Statistics in the Department of Labor, selected clusters which seemed to encompass all existing job opportunities in Oregon.

To help high schools develop cluster programs and appropriate occupational experiences for students, curriculum guides have been written for each of the clusters selected. This particular guide outlines the basic skills and knowledge necessary for entry-level competencies in the broad field of building construction, or for entrance into a post-high school or university program.

We have used a continuum concept and an analytical approach in developing the cluster guides which should assure that they will be kept up to date in relation to current industrial trends and practices. The guides are built around the premise that teachers in our high schools and employers in business and industry will participate in a continuous evaluation and updating process so that obsolescence in occupational education programs can be minimized.

LEONARD E. KUNZMAN
Director
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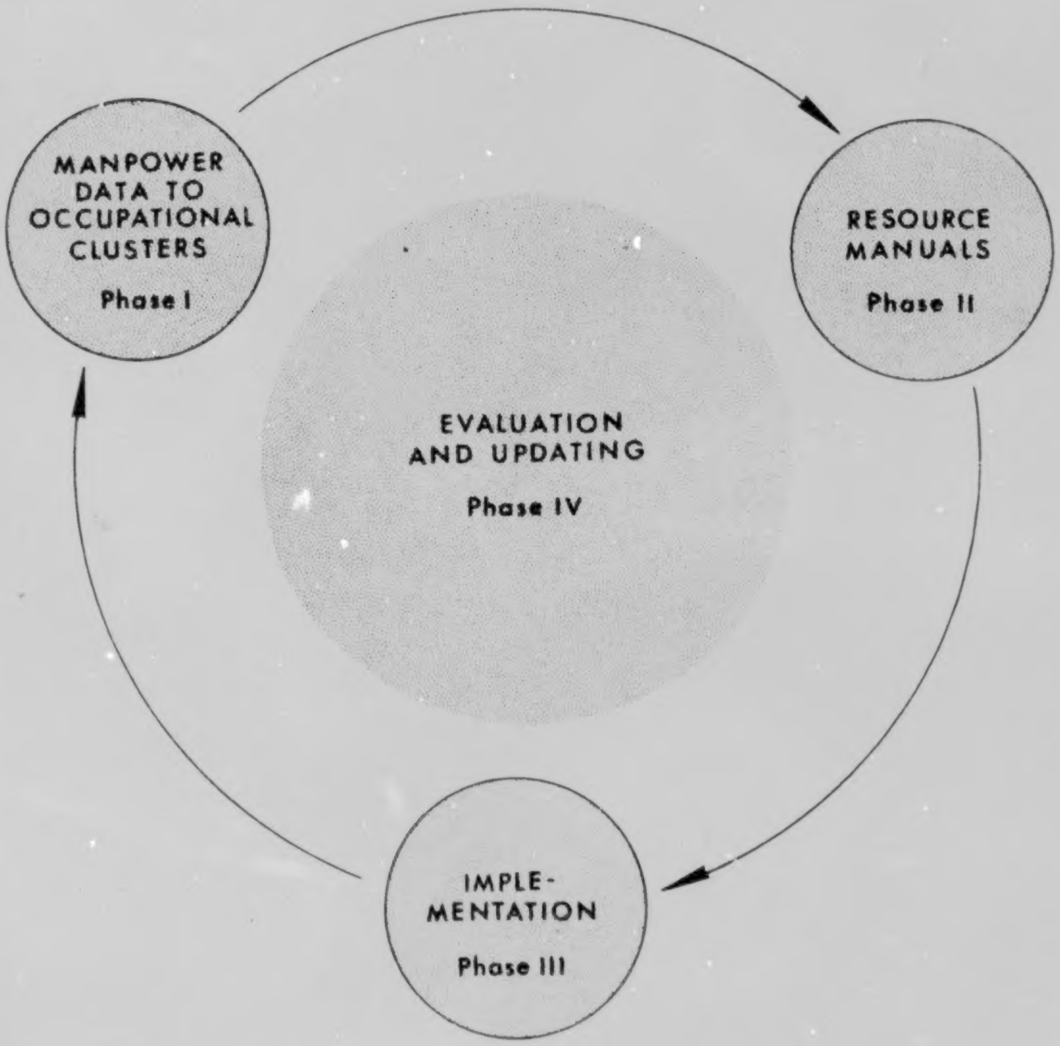
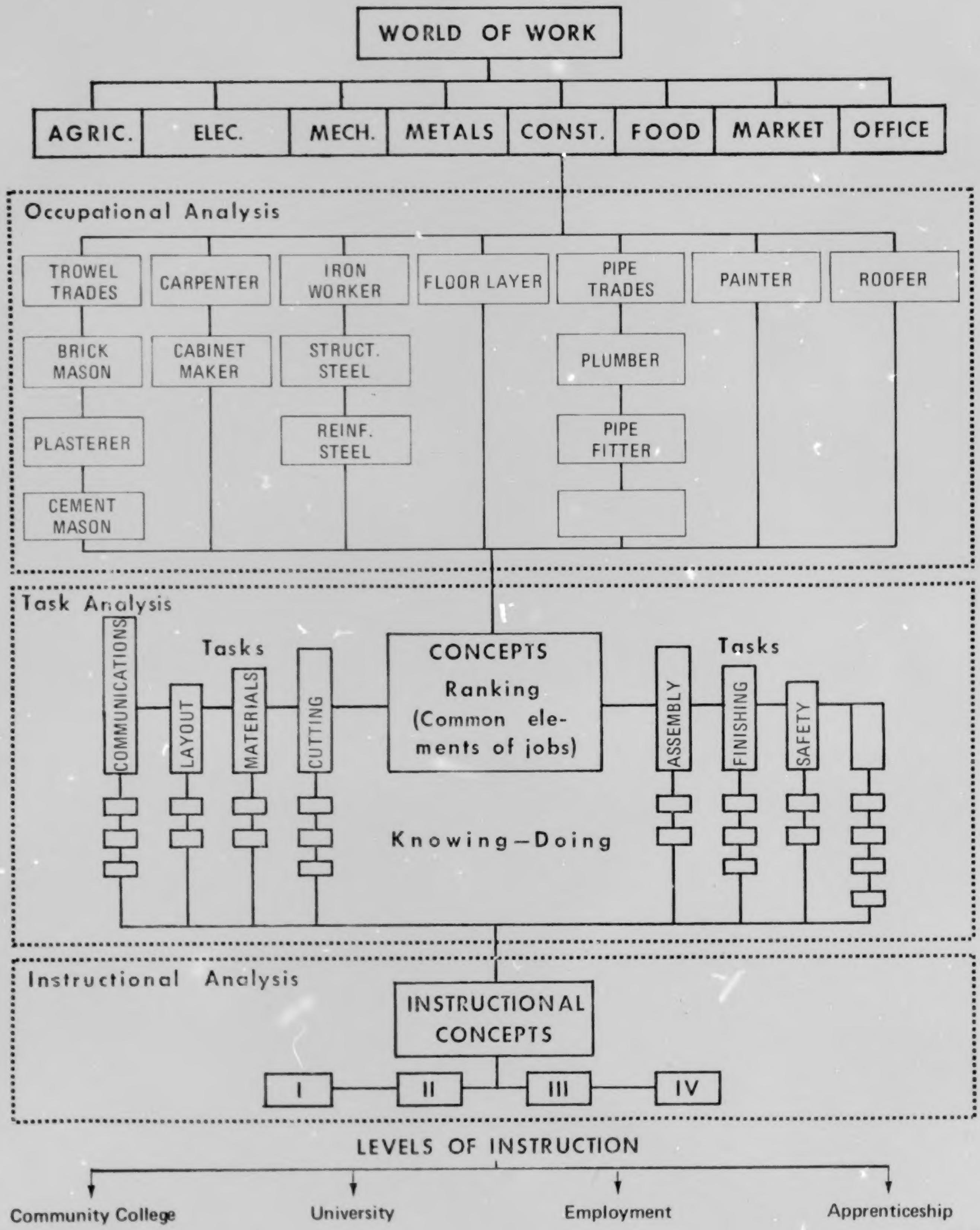
OCCUPATIONAL CLUSTER CONTINUUM


MANPOWER DATA TO OCCUPATIONAL CLUSTERS
Phase I
RESOURCE MANUALS
Phase II
EVALUATION AND UPDATING
Phase IV
IMPLEMENTATION
Phase III


WORLD OF WORK
AGRIC.
ELEC.
MECH.
METALS
CONST.
FOOD
MARKET
OFFICE
Occupational Analysis
TROWEL TRADES
CARPENTER
IRON WORKER
FLOOR LAYER
PIPE TRADES
PAINTER
ROOFER
BRICK MASON
CABINET MAKER
STRUCT. STEEL
PLUMBER
PLASTERER
REINF. STEEL
PIPE FITTER
CEMENT MASON
Task Analysis
Tasks
COMMUNICATIONS
LAYOUT
MATERIALS
CUTTING
CONCEPTS
Ranking
(Common elements of jobs)
Tasks
ASSEMBLY
FINISHING
SAFETY
Knowing–Doing
Instructional Analysis
INSTRUCTIONAL CONCEPTS
I
II
III
IV
LEVELS OF INSTRUCTION
Community College
University
Employment
Apprenticeship

OCCUPATIONAL AND INSTRUCTIONAL DATA

The purpose of this construction cluster guide is to provide teachers with instructional specifications for developing a curriculum that will give students background information about the building construction industry and help them develop the competencies necessary for entering the career trades of their choice. From an initial listing of over 60 trades directly related to construction, seven groups of trades were selected for detailed analysis. Selection of the groups was based upon Oregon employment data and upon the decision to avoid duplication of specific trades already included in other operating curriculum guides; i.e., electrical, and metal fabrication. The seven key occupations representing the construction cluster are:

1. Carpenter
2. Trowel trades
3. Iron worker
4. Pipe trades
5. Floor layer
6. Painter
7. Roofer

Dictionary of Occupational Titles job descriptions are included in this section, along with Oregon manpower data concerning the key occupations, and analysis of the task areas that are common to all so that teachers can plan course content according to the particular needs of their students and the facilities available in their schools.

In addition, an instructional analysis is included to provide teachers with a tool for planning learning experiences.

D.O.T. CODE 860.381
JOB TITLE: CARPENTER, CONSTRUCTION

1. Reads blueprints, shop drawings, and detail sheets.
   Instructional Code: 1.3

2. Determines materials required, dimensions, design, finish, and structural frame of structure or fixture to be erected.
   Instructional Code: 1.3

3. Lays out, cuts, shapes, fits, and assembles wood and wood-related materials.
   Instructional Code: 2.1, 2.21, 3.1, 4.11, 5.11, 5.21

4. Verifies vertical and horizontal alignment and trueness of assembled members.
   Instructional Code: 2.3

5. Erects scaffolding and ladders.
   Instructional Code: 7.1

6. Lays out and builds concrete forms.
   Instructional Code: 2.1, 2.2, 4.1, 5.1

7. Cuts and welds small metal parts.
   Instructional Code: 5.47

8. Signals equipment operator and others in moving and placing materials.
   Instructional Code: 7.23

9. Fits and installs prefabricated units and finish hardware.
   Instructional Code: 5.5

10. Understands and practices construction safety.
    Instructional Code: 7.4

11. Understands concrete technology.
    Instructional Code: 3.55

12. Understands and conforms to local building code requirements.
    Instructional Code: 1.6

D.O.T. CODE 861.361
JOB TITLE: BRICKLAYER, CONTRUCTION (Trowel Trades)

1. Lays out, sets and fits, cuts or breaks brick, tile and block.
   Instructional Code: 2.22, 3.5, 4.1, 4.2

2. Verifies vertical, horizontal, and face alignment of members.
   Instructional Code: 2.22, 2.3

3. Mixes, applies, beds, cleans and finishes mortar.
   Instructional Code: 3.56, 5.46, 6.45

4. Fastens veneer brick and block to adjoining structural members.
   Instructional Code: 3.56, 3.57, 5.46

5. Erects scaffolds and ladders.
   Instructional Code: 7.1

6. Forms, mixes and pours concrete for bond beams, headers, sills, etc.
   Instructional Code: 2.1, 2.2, 4.1, 5.1

7. Welds small metal parts to adjacent steel members.
   Instructional Code: 5.35, 5.47

8. Understands concrete technology.
   Instructional Code: 3.55

9. Understands and practices construction safety.
   Instructional Code: 7.4

10. Determines type, size, shape and location of brick or block from prints or sketches.
    Instructional Code: 1.3

11. Reads blueprints, shop drawings, and detail sheets.
    Instructional Code: 1.3

D.O.T. CODE 842.781
JOB TITLE: PLASTERER (Trowel Trades)

1. Lays out, mixes, applies, and finishes interior and exterior plaster.
   Instructional Code: 2.22, 3.5, 5.46, 6.45
2. Verifies thickness, planes, and lines of plastered surface.
   Instructional Code: 1.3, 2.22, 2.3
3. Erects scaffold and elevated work platforms.
   Instructional Code: 7.1
4. Installs precast ornamental plaster pieces.
   Instructional Code: 5.3, 5.4
5. Reads blueprints, show drawings, and detail sheet.
   Instructional Code: 1.3
6. Understands and practices construction safety.
   Instructional Code: 7.4
7. Determines size, location, mix, base coats and finish from blueprints or sketches.
   Instructional Code: 1.3

D.O.T. CODE 844.884
JOB TITLE: CEMENT MASON (Trowel Trades)

1. Spreads, levels, smooths, shapes, and finishes freshly poured concrete.
   Instructional Code: 6.13, 6.3, 6.45

2. Patches, grinds, and finishes prepoured concrete surfaces.
   Instructional Code: 6.41

3. Understands concrete technology.
   Instructional Code: 3.56

4. Lays out and constructs concrete forms, screeds, and pouring chutes.
   Instructional Code: 2.1, 2.2, 4.1, 5.1

5. Estimates quantities, finish, design, and strength requirements of concrete from blueprints or sketches.
   Instructional Code: 1.3

6. Understands and practices construction safety.
   Instructional Code: 7.4

7. Signals equipment operator or others in moving and placing materials.
   Instructional Code: 7.23

8. Erects scaffolds and ladders.
   Instructional Code: 7.1

9. Understands and conforms to local building code requirements.
   Instructional Code: 1.61

D.O.T. CODE 862.381
JOB TITLE: PLUMBER–PIPE FITTER (Pipe Trades)

1. Lays out, marks, and cuts openings to accommodate pipe and fittings.
   Instructional Code: 2.12, 2.23, 2.3, 4.1, 4.2

2. Lays out, marks, cuts or breaks, bends, and fastens pipe and fittings.
   Instructional Code: 2.23, 2.3, 3.21, 4.12, 4.22, 5.12, 5.22

3. Assembles and installs valves, fixtures, and trim.
   Instructional Code: 5.5

4. Reads blueprints, shop drawings, and detail sheets.
   Instructional Code: 1.3

5. Determines size, location, and installation data of pipe and fixtures from prints or sketches.
   Instructional Code: 1.3, 2.12

6. Cuts and welds small metal parts.
   Instructional Code: 4.12, 4.22, 5.35, 5.47

7. Understands and conforms to state and local requirements. License necessary.
   Instructional Code: 1.61

D.O.T CODE 801.781-801.884
JOB TITLE: STEEL WORKER, STRUCTURAL–REINFORCING

1. Lays out, cuts and forms, fits and fastens steel members.
   Instructional Code: 2.12, 2.24, 3.2, 4.12, 4.22, 5.12, 5.22
2. Verifies vertical and horizontal alignment of members.
   Instructional Code: 2.3
3. Determines number, size, shape and location of members from prints or sketches.
   Instructional Code: 1.3, 2.12
4. Reads blueprints, shop drawings, and detail sheets.
   Instructional Code: 1.3
5. Understands and practices construction safety.
   Instructional Code: 7.4
6. Signals equipment operator and others in moving and placing materials.
   Instructional Code: 7.23
7. Cuts and welds metal parts.
   Instructional Code: 4.12, 4.22, 5.35, 5.47
8. Erects scaffolds and ladders.
   Instructional Code: 7.1
9. Understands and conforms to local building code requirements.
   Instructional Code: 1.61
10. Understands concrete technology.
    Instructional Code: 3.55
11. Sets up and dismantles hoisting equipment.
    Instructional Code: 7.2

D.O.T. CODE 864.781 and 763.884
JOB TITLE: FLOOR LAYER AND PLASTIC TOP INSTALLER

1. Lays out, cuts, forms, fits and installs linoleum, tile, and plastic floor and wall coverings.

   Instructional Code: 2.12, 2.25, 3.6, 4.1, 4.2, 5.1, 5.2, 5.34, 5.46

2. Prepares surface to receive covering.

   Instructional Code: 6.2

3. Applies adhesives.

   Instructional Code: 3.52, 5.46

4. Verifies centerlines and borderlines.

   Instructional Code: 2.3

5. Reads blueprints and sketches for type of materials, design of covering, colors and patterns.

   Instructional Code: 1.3

6. Understands and practices construction safety.

   Instructional Code: 7.4

D.O.T. CODE 840.781
JOB TITLE: PAINTER, CONSTRUCTION

1. Prepares surfaces for covering.
   Instructional Code: 6.2

2. Selects, mixes, and applies paints and related products.
   Instructional Code: 6.4

3. Erects scaffolds and ladders.
   Instructional Code: 7.1

4. Cleans painting equipment and area.
   Instructional Code: 7.42

5. Covers interior walls and ceilings with decorative wallpaper or fabric.
   Instructional Code: 3.6

6. Fills nail holes, cracks and joints with putty, plaster or filler.
   Instructional Code: 6.2

7. Understands and practices construction safety.
   Instructional Code: 7.4

D.O.T. CODE 866.381
JOB TITLE: ROOFER

1. Lays out, cuts, fits, and fastens roofing materials.
   Instructional Code: 2.12, 3.51, 3.6, 4.1, 4.2, 5.1, 5.2
2. Aligns roofing materials with roof edge and successive layers.
   Instructional Code: 2.27
3. Melts, hoists, and applies liquid roofing cements.
   Instructional Code: 3.51, 6.11
4. Erects scaffolds and ladders.
   Instructional Code: 7.1
5. Cuts and fits flashing to form weatherproof angles.
   Instructional Code: 2.27, 4.22
6. Understands and practices construction safety.
   Instructional Code: 7.4
7. Reads blueprints, shop drawings, and detail sheets.
   Instructional Code: 1.3
8. Signals equipment operator and others in moving materials.
   Instructional Code: 7.23

OREGON MANPOWER DATA FOR SECONDARY CURRICULA
CONSTRUCTION OCCUPATIONS

D.O.T. No.	Key Occupations for Analysis Process	Pres. Empl.	Proj. Need 1975	D.O.T. No.	Key Occupations 250 Employed 100 Expansion and Replacement	Pres. Empl.	Proj. Need 1975	D.O.T. No.	Related Occupations 100 or more employed	Pres. Empl.	Proj. Need 1975
860.381	Carpenter, Construction	6,368	2,503	660.280	Cabinet Maker	774	398	861.381	Brick Layer	209	103
844.884	Cement & Concrete Finisher	622	175	860.381	Carpenter, Construction	6,368	2,503	869.281	Furnace Installer & Repair—Hot Air	268	87
864.781	Floor Layer & Finishing Occupation	597	98	899.381	Carpenter, Maintenance	284	100	865.781	Glazier & Related Occupations	281	54
840.781	Painter, Const. & Maintenance	1,423	558	860.781	Carpenter, Rough	404	175	862.281	Oil Burner & Furnace Repairman	181	44
862.381	Pipe Fitter	1,951	345	844.884	Cement & Concrete Finisher	622	175	866.887	Roofer Helper	167	-15
842.781	Plasterer & Related Occupations	506	201	869.884- 869.887	Const. Worker	2,284	770	861.781	Tile Setter	198	56
866.381	Roofer	651	182	824.281	Electrician	3,129	1,374	860.381	Shipwright	264	123
801.781	Structural Steel Worker	451	190	864.781	Floor Layer & Finishing Occupation	597	98				
				863.884	Insulation Worker	516	107				
				840.781	Painter, Const. & Maintenance	1,423	558				
				862.381	Pipe Fitter	1,951	345				
				842.781	Plasterer & Related Occupations	506	201				
				862.381	Plumber	2,214	548				
				860.887	Laborers, Carpentry	1,342	479				
				866.381	Roofer	651	182				
				801.781	Structural Steel Worker	451	190				

TASK ANALYSIS FOR DETERMINING COURSE CONTENT

ON-THE-JOB TASKS	IRON WORKER	ROOFER	PIPE TRADES	TROWEL TRADES	FLOOR-TILE LAYER	CARPENTER	PAINTER	IDENTIFICATION CODE	DIVISION CODE	INSTRUCTIONAL CODE
Has acceptable attitude toward work	X	X	X	X	X	X	X	1	1.1	
Understands related construction trades	X	X	X	X	X	X	X		1.2	
Reads and understands plans, shop drawings, detail sheets	X	X	X	X	X	X	X		1.3	
Estimates materials required	X	X	X	X	X	X	X		1.3	
Uses math, algebra, geometry	X	X	X	X	X	X	X		1.5	
Understands building code requirements	X	X	X	X	X	X	X			1.61
Makes layout	X	X	X	X	X	X	X	2		
Verifies alignment of members	X	X	X	X	X	X	X		2.3	
Uses construction hand and power tools	X	X	X	X	X	X	X		2.3 4.2 5.4 6.4	
Understands tool and machine maintenance	X	X	X	X	X	X	X		2.3 4.4 5.4 6.4	
Understands concrete technology	X			X		X				3.55
Uses cutting tools	X	X	X	X	X	X	X	4		
Cuts and fits members to be installed	X	X	X	X	X	X	X	4		
Fastens members to structure	X	X	X	X	X	X		5		
Uses fastening tools	X	X	X	X	X	X			5.4	
Assembles and installs	X	X	X		X	X			5.5	
Makes forms for and pours concrete	X			X		X			2.2	
Solders, brazes, welds fittings and fixtures			X							5.47
Removes and cleans concrete forms				X		X			5.1 5.2	5.37
Mixes plastic and liquid materials				X	X		X			3.3
Cuts and welds small metal parts	X		X	X		X				4.22 5.47
Applies and finishes materials	X	X	X	X	X	X	X	6		
Prepares surface and materials for finishing or refinishing				X	X	X	X		6.2	
Erects scaffolds and ladders	X	X		X		X	X	7	7.1	
Sets up and dismantles hoisting equipment	X	X	X	X		X	X		7.2	
Understands rigging and heavy moving	X					X				7.22
Controls operator in moving and placing materials	X			X		X				7.23
Understands and practices construction safety	X	X	X	X	X	X	X		7.4	

INSTRUCTIONAL ANALYSIS FOR ORGANIZING LEARNING EXPERIENCES

	CARPENTER	TROWEL TRADES	PIPE TRADES	IRON WORKERS	FLOOR LAYER	PAINTER	ROOFER	IDENTIFICATION CODE	DIVISION CODE	INSTRUCTIONAL CODE
COMMUNICATION								1		
The World of Work									1.1	
Attitude development	X	X	X	X	X	X	X			1.11
Worker responsibility	X	X	X	X	X	X	X			1.12
Construction industry–basic concepts									1.2	
Comparative analysis of trades	X	X	X	X	X	X	X			1.21
Sequence of construction	X	X	X	X	X	X	X			1.22
Pay–basis, trades differential	X	X	X	X	X	X	X			1.23
Relationships–worker and supervisor, contractor, owner, architect	X	X	X	X	X	X	X			1.24
The role of organized labor	X	X	X	X	X	X	X			1.25
Apprenticeship–organization and program	X	X	X	X	X	X	X			1.26
Physical and mental requirements	X	X	X	X	X	X	X			1.27
Leadership standards and personal development	X	X	X	X	X	X	X			1.28
Written communications									1.3	
Plans reading	X	X	X	X	X	X	X			1.31
Specifications	X	X	X	X	X	X	X			1.32
Symbols–building trades	X	X	X	X	X	X	X			1.33
Sketching	X	X	X	X	X	X	X			1.34
Schedules–preparation, use	X	X	X	X	X	X	X			1.35
Diagrams, schematics	X	X	X	X	X	X	X			1.36
Work orders	X	X	X	X	X	X	X			1.37
Reading–understanding written instructions	X	X	X	X	X	X	X			1.38
Writing–materials requirements	X	X	X	X	X	X	X			1.39
Oral communications									1.4	
Getting a job	X	X	X	X	X	X	X			1.41
Following oral instructions	X	X	X	X	X	X	X			1.42
Language–terms, definitions	X	X	X	X	X	X	X			1.43
Related mathematics									1.5	
Basic arithmetic	X	X	X	X	X	X	X			1.51
Fractions	X	X	X	X	X	X	X			1.52
Decimals	X	X	X	X	X	X	X			1.53
Measurement–area, volume, etc.	X	X	X	X	X	X	X			1.54
Ratio–proportion	X	X	X	X	X	X	X			1.55
Powers and roots	X		X							1.56
Applied geometry	X	X	X	X	X	X	X			1.57
Construction standards									1.6	
Construction codes	X	X	X	X	X	X	X			1.61
LAYOUT								2		
General applications									2.1	
Surveying–site and building layout	X	X	X	X						2.11
Transferring plans information	X	X	X	X	X	X	X			2.12
Trade Application									2.2	
Carpentry	X									2.21
Trowel trades		X								2.22
Plumbing			X							2.23
Iron Working				X						2.24
Floor Laying					X					2.25
Painting						X				2.26
Roofing							X			2.27

	CARPENTER	TROWEL TRADES	PIPE TRADES	IRON WORKERS	FLOOR LAYER	PAINTER	ROOFER	IDENTIFICATION CODE	DIVISION CODE	INSTRUCTIONAL CODE
Layout tools									2.3	
Measurement–tape, rule	X	X	X	X	X	X	X			2.31
Levels–hand, builders	X	X	X	X	X	X	X			2.32
Lines–chalk lines, straight edge	X	X	X	X	X	X	X			2.33
Squares	X	X	X	X	X	X	X			2.34
Plumb bob	X	X	X	X	X	X	X			2.35
Marking tools	X	X	X	X	X	X	X			2.36
CONSTRUCTION MATERIALS								3		
Woods									3.1	
Softwoods	X	X	X	X	X	X	X			3.11
Hardwoods	X				X	X				3.12
Plywoods	X	X	X	X	X	X	X			3.13
Wood products	X	X	X	X	X	X	X			3.14
Metals									3.2	
Ferrous metals	X	X	X	X	X	X	X			3.21
Nonferrous metals	X	X	X	X	X	X	X			3.22
Plastics	X	X	X	X	X	X	X		3.3	
China, porcelain	X	X	X		X	X			3.4	
Miscellaneous									3.5	
Asphalts, tars	X	X	X	X	X	X	X			3.51
Glues, cements	X	X	X	X	X	X	X			3.52
Finishes–paints, varnishes	X	X			X	X				3.53
Specialties–binders, dryers, etc.	X	X	X	X	X	X	X			3.54
Cement, aggregates	X	X			X	X	X			3.55
Gypsum and Lime	X	X								3.56
Clay products	X	X	X				X			3.57
Coverings									3.6	
Fabrics	X	X	X	X	X	X	X			3.61
Linoleum, tiles	X				X					3.62
Glass	X	X	X	X	X	X	X			3.63
Paper products	X	X	X	X	X	X	X			3.64
CUTTING AND FITTING								4		
Cutting characteristics of materials									4.1	
Woods	X	X	X	X	X	X	X			4.11
Metals	X	X	X	X	X	X	X			4.12
Plastics	X	X	X	X	X	X	X			4.13
Miscellaneous materials	X	X	X	X	X	X	X			4.14
Selection of cutting tools									4.2	
Woods	X	X	X	X	X	X	X			4.21
Metals	X	X	X	X	X	X	X			4.22
Plastics	X	X	X	X	X	X	X			4.23
Miscellaneous materials	X	X	X	X	X	X	X			4.24
Measuring and marking	X	X	X	X	X	X	X		4.3	
Maintenance of cutting tools	X	X	X	X	X	X	X		4.4	
Cutting tools–saws									4.5	
Handsaws, hacksaws	X	X	X	X	X		X			4.51
Circular saws	X	X	X	X	X					4.52
Band, jig, reciprocating	X	X	X	X	X					4.53

	CARPENTER	TROWEL TRADES	PIPE TRADES	IRON WORKERS	FLOOR LAYER	PAINTER	ROOFER	IDENTIFICATION CODE	DIVISION CODE	INSTRUCTIONAL CODE
Cutting tools–knives									4.6	
Chisels	X	X	X	X	X	X	X			4.61
Knives, scoring tools	X	X	X	X	X	X	X			4.62
Planes, planers	X				X					4.63
Cutting tools–shears									4.7	
Snips, scissors	X	X	X	X	X	X	X			4.71
Pipe and tubing cutters	X		X							4.72
Abrading cutting tools									4.8	
Files, rasps	X	X	X	X	X	X	X			4.81
Papers, stones, belts, wheels	X	X	X	X	X	X	X			4.82
Miscellaneous cutting tools									4.9	
Burning torch	X	X	X	X						4.91
Acids		X				X				4.92
Drills	X	X	X	X	X	X	X			4.93
ASSEMBLY								5		
Fastening characteristics of materials									5.1	
Woods	X	X	X	X	X	X	X			5.11
Metals	X	X	X	X	X	X	X			5.12
Plastics	X	X	X	X	X	X	X			5.13
Miscellaneous materials	X	X	X	X	X	X	X			5.14
Selection of fasteners									5.2	
Woods	X	X	X	X	X	X	X			5.21
Metals	X	X	X	X	X	X	X			5.22
Plastics	X	X	X	X	X	X	X			5.23
Miscellaneous materials	X	X	X	X	X	X	X			5.24
Types of fasteners									5.3	
Drive-in–nails, staples, rivets	X	X	X	X	X	X	X			5.31
Screw-in–screws	X	X	X	X	X	X	X			5.32
Bolts	X	X	X	X	X	X	X			5.33
Glues, cement	X	X	X		X	X	X			5.34
Welds, solder	X	X	X	X	X					5.35
Clamp-ons, clips	X	X	X	X	X	X	X			5.36
Wire, ties, band	X	X	X	X	X	X	X			5.37
Fastening tools, hand and power									5.4	
Clamps	X	X	X	X	X	X	X			5.41
Hammers	X	X	X	X	X	X	X			5.42
Screwdrivers	X	X	X	X	X	X	X			5.43
Staplers	X	X	X	X	X	X	X			5.44
Wrenches, pliers	X	X	X	X	X	X	X			5.45
Trowels, spreaders	X	X			X	X	X			5.46
Welders, solder tools	X	X	X	X	X					5.47
Assembly and Installation	X	X	X	X	X	X	X		5.5	
FINISHING								6		
Finishes–categories, characteristics									6.1	
Protective	X	X	X	X	X	X	X			6.11
Decorative	X	X	X	X	X	X	X			6.12
Functional	X	X	X	X	X	X	X			6.13

	CARPENTER	TROWEL TRADES	PIPE TRADES	IRON WORKERS	FLOOR LAYER	PAINTER	ROOFER	IDENTIFICATION CODE	DIVISION CODE	INSTRUCTIONAL CODE
Preparation of surfaces and/or materials									6.2	
Woods	X				X	X				6.21
Metals	X	X	X	X	X	X	X			6.22
Miscellaneous materials	X	X	X	X	X	X	X			6.23
Fillers, caulking, weatherproofing	X	X	X	X	X	X	X			6.24
Finishing techniques									6.3	
Finishing tools									6.4	
Abrasives, grinders	X	X	X	X	X	X	X			6.41
Brushes, rollers	X	X			X	X	X			6.42
Sprays	X	X	X	X	X	X	X			6.43
Buffers, polishers					X	X				6.44
Trowels	X	X			X	X	X			6.45
Trim tools	X	X			X	X	X			6.46
SAFETY								7		
Ladders and scaffolds									7.1	
Safety codes	X	X	X	X	X	X	X			7.11
Construction, uses, types	X	X	X	X	X	X	X			7.12
Hoisting and lifting									7.2	
Safety codes	X	X	X	X	X	X	X			7.21
Rigging	X	X	X	X	X	X	X			7.22
Signals	X	X	X	X	X	X	X			7.23
Shop safety									7.3	
Safety codes	X	X	X	X	X	X	X			7.31
General safety	X	X	X	X	X	X	X			7.32
Machine safety	X	X	X	X	X	X	X			7.33
Construction safety									7.4	
Safety codes	X	X	X	X	X	X	X			7.41
Practices										7.42

CLUSTER CURRICULUM

The construction cluster curriculum is intended for those students planning to enter one of the construction trades after completion of high school.

This curriculum is concerned with the broad field of building construction, rather than with any specific trade. Entry-level knowledge and skill factors are grouped by common functions rather than by trades.

A building construction program should encompass:

Occupational Exploratory Experiences in Grades Seven Through Ten. They are of prime importance to students developing career goals and plans. Courses in industrial arts, drawing, industrial English, mathematics, and sciences will provide valuable prerequisite experiences for the building construction cluster in grades 11 and 12.

Occupational Guidance. Helping students to learn more about themselves, to learn about the World of Work, to determine their interests and aptitudes for further education or for a vocational career, and to choose an occupational field which will offer them both challenge and self-fulfillment is the heart of a successful occupational educational program.

Cooperative Work Experience Programs. These should be approved by the Division of Community Colleges and Career Education, but could make up a portion of the curriculum time during the last half of the 12th year. A State Department of Education publication, *Cooperative Work Experience, A Coordinator's Manual,* will supply the details of establishing such a program.

Occupational Cluster Course in Grades 11 and 12. This course should be allocated a segment of time approximating two periods per day or ten hours per week. This amount of time is minimal for the study and experience required to achieve curriculum objectives. The instructional specifications for the course begin on page 29. They are organized into the following major areas of concern:

Communications
Layout
Cutting and fitting
Fastening and assembly
Construction materials
Finishing
Safety

Allied Supporting Elective Courses. The student should be able to choose supplemental learning experiences which will sharpen his particular interests and talents and help him attain his occupational objectives. A list of recommended allied supporting elective courses is suggested on page 24.

A suggested construction cluster curriculum is presented on page 22.

The Oregon Board of Education recognizes that each local school district will encounter unique problems in scheduling when undertaking the implementation of the secondary occupational cluster program. The suggested time blocks are governed by the State Plan for Vocational Education and, within those limitations, are flexible and can be adapted to the needs of the local school district.

OBJECTIVES

The philosophical foundation of the following curriculum objectives can be found in the *Guide to Structure and Articulation of Occupational Education Programs.** While these objectives are considered basic to this particular cluster, it is anticipated that more specific objectives will be developed by teachers for various age and grade levels.

The broad objective of a construction cluster curriculum is to provide students with the entry-level skills and knowledge common to a variety of occupations so that, upon graduation, they may become productively employed in the construction industry, or continue with more advanced training.

Students who complete a building construction career cluster program should have:

- Knowledge of construction materials, their sources, production, development, characteristics and uses
- An understanding of the principles of planning, methods of plan interpretation, estimating, and procedures of construction
- Skill in the use, care, and maintenance of tools, machines, and equipment used in building construction
- Ability to understand and apply city, county, and state laws and regulations affecting the building construction industry
- An understanding of building functions, location, and design as they apply to industry, business, and residential activities
- Knowledge of the manufacturing and distribution processes related to the products and prefabricated units utilized in the construction industry
- An understanding of the work flow and responsibilities of the various skilled trades and crafts which execute the plans and specifications provided by the professional designer
- Knowledge of safety practices and how they relate to the construction industry
- Knowledge of supportive general and scientific disciplines common to the construction industry
- An understanding of the skills and uses of leadership

**Guide to Structure and Articulation of Occupational Education Programs (Grades 7 through 12 and post-high school)*, State Department of Education, Division of Community Colleges and Vocational Education, Salem, Oregon 97310.

BUILDING CONSTRUCTION CLUSTER CURRICULUM
A SUGGESTED CURRICULUM PLAN

PER	7TH & 8TH GRADES	9TH GRADE	10TH GRADE	11TH GRADE	12TH GRADE
1	Social Studies	Communication Skills	Communication Skills	Communication Skills	Communication Skills
2	Language Arts	Mathematics	Mathematics II or Algebra	U.S. History	Humanities Electives
3	Mathematics	Health and Physical Education	Health and Physical Education	Health and Physical Education	**Allied Supporting Electives
4	Health and Physical Education	Science	Science	**Allied Supporting Electives	**Allied Supporting Electives
5	Science General Music	CAREER ORIENTATION		CLUSTER	CLUSTER
6	Career Exploratory Industrial Arts	*Industrial Arts* Exploratory	Speciality	CURRICULUM	CURRICULUM

*Functions of Industry–Materials & Processes, Power & Mechanics, Electricity/Electronics, Graphics/Communications

**Recommended allied supporting courses. A brief definition of each course is found on page 24.

- Business Law
- Business Organization & Management
- Economics
- General Business
- Graphic Communications
- Industrial Math
- Basic Electricity
- Basic Metal Working
- Welding Fundamentals
- Basic Mechanics
- Basic Psychology
- Blueprint Reading and Sketching
- Finished Wood Materials

NOTE: Cooperative work experience should be included as an integral part of the Cluster Curriculum.

SUGGESTIONS FOR CURRICULUM DEVELOPMENT

A quick review of the instructional specifications which begin on page 27, will reveal that they are not organized into sequential teaching units or training courses for each of the key occupational areas. Rather, necessary entry-level skills and knowledge for the seven occupations are categorized according to their most common characteristics. For example, the section dealing with layout covers the basic tools and techniques that all building construction workers should be familiar with, as well as identifying some layout techniques or skills that are required in specific occupations only.

Thus, to develop a fully individualized curriculum, teachers will need to use the task analysis on page 13, also the instructional analysis on page 14, to select the portions of each unit of the instructional specifications that are appropriate to his students' needs. It is suggested that the careful selection and development of *building construction projects* might be the most effective way to build a cluster curriculum. The types of projects selected by each school might vary in relation to facilities, tools and machines, climate, community resources, teacher experience and teacher-pupil ratios.

Whatever the project, it should require that the students involved learn something about the types and characteristics of *construction materials* that might be used, the *layout* techniques and tools for such materials, *cutting and fitting* techniques, *fastening or assembly* techniques, and finally, methods of *finishing*. The knowledge and skills listed in the sections dealing with *communication* and *safety* should be learned as they apply to each project activity.

Projects should increase in complexity and continually provide new experience in each of the above categories.

The danger in using projects as learning vehicles lies in the tendency to use a project as an end in itself, rather than as a means for perfecting skills and evaluating progress. Teachers should avoid using any projects that do not provide experiences in each of the areas of building construction, or that do not exemplify construction techniques or environment.

ALLIED SUPPORTING COURSES

The following list of allied supporting courses is recommended to students planning to enter, or those already enrolled in, the building construction cluster curriculum.

Industrial arts programs provide many of the opportunities mentioned in the course descriptions, although course titles do not remain constant. This does not limit their scope or effectiveness in supplying learning experiences in these areas. In most cases, the existing program, with only slight modification of content, will provide the experiences suggested in the following course descriptions.

Courses generally found in the high school curriculum, such as Basic Economics, Speech, Technical Writing, General Science, Mathematics, Trigonometry, etc., also are supporting courses and should be considered when choosing electives.

The student must consider all courses available and discuss various alternatives with his parents, school counselors, and advisors. This will help him choose an educational program with realistic career-oriented experiences and objectives.

COURSE DESCRIPTIONS

Industrial Math

A course designed to provide students the necessary basic (shop) math skills to succeed in the industrial field. The math should be concerned with the basics necessary for the student to succeed in his chosen cluster area.

Basic Electricity

A basic course in fundamentals, covering magnetism and electricity. Laboratory time is provided for demonstrations and experiments to help classify the principles of basic electricity, specifically Ohms Law. Emphasis is placed on the use and care of electrical machinery. Stress is placed on the field analysis of electrical failure, and use of equipment and electrical test devices to determine and make needed repairs on electric motors, switches, and transfer equipment.

Basic Metalworking and Machine Tools

The fundamentals of basic metals and machine tools used in industry, including the theory and application of machine tools in forming and shaping metals most commonly used to fabricate machine parts and assemble components. The student will learn the basic operation of the drill press, lathe, shaper, and grinder. Some basic metallurgy will also be taught.

Basic Psychology

A course designed to cover such topics as emotional development, man's basic needs, man as a member of a family unit and of society, defense mechanisms, life adjustment process, principles of mental health, and the art of getting along with people.

Blueprint Reading and Sketching

Principles of reading and interpreting blueprints and techniques of making working sketches.

Business Law

Emphasizes the application of legal and ethical aspects of law and practice to business situations. Various forms of contracts and negotiable instruments are presented, along with sales, bailments, partnerships, corporations, insurance and other legal matters pertaining to business.

Business Organization and Management

A study of ownership and organization for management. The advantages and disadvantages of each type of organization for ownership are examined. The course also focuses attention on purchasing, merchandising, unions, production, financing, and personnel management.

Economics

A course designed to provide insights into basic economic concepts, how our economic system works, its effect on our way of life, values, and environment including the role of money, the distribution of society's products, common yardsticks for measuring economic progress, the role of profit, etc. Course objectives would be to help prepare students to make valid economic judgments in personal as well as vocational and social choices.

Finished Wood Materials

Designed to provide instruction in the development, selection, and use of wood products for furniture, paneling, flooring, decorative accessories and fixtures, luggage, sporting equipment, boats, display signs and stands, packaging, etc. Special attention is given to the physical properties of hardwoods.

General Business

Emphasizes the consumer aspects of business and economics and is available to all students. This general business course examines such areas as banking services, credit and collection, purchasing goods and services, insurance, savings and investment, and the keeping of personal records.

Graphic Communications

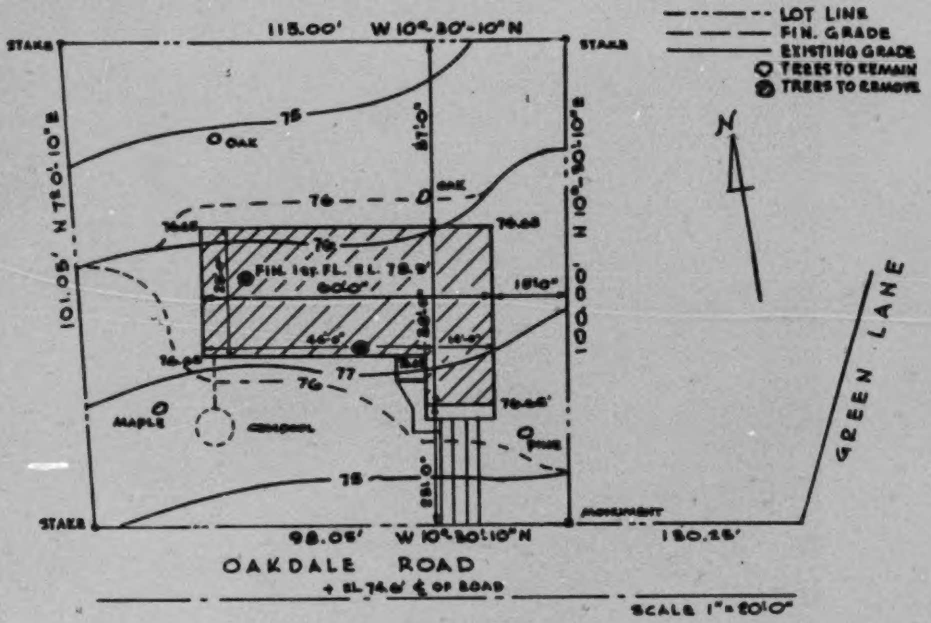
Includes instruction and practices in principles of visualization, oral communication, technical sketching, basic drafting, blueprint reading, shop processes, specification and tolerancing, photography, and printing. Specific technical information is correlated with laboratory experiences to provide an opportunity for students to develop a fundamental concept of methods for communicating ideas; i.e., schematic drawings, blueprints, technical manuals, and oral and written language.

Welding Fundamentals

A lecture, demonstration, and laboratory course covering fundamentals of oxyacetylene, electrical welding, soldering, and brazing of ferrous and nonferrous metals.

Industrial Mechanics Systems

A course designed to provide understanding of the fundamental principles and to develop competencies in the applications of mechanical systems. This course may include study of the internal combustion engine, basic hydraulic and pneumatic systems, electrical circuits, and transmission systems, and the relationship of the components to the complete circuit or system. Fundamental concepts include the operation, use, selection, installation, maintenance, and application of systems.



LOT LINE
FIN. GRADE
EXISTING GRADE
TREES TO REMAIN
TREES TO REMOVE
115.00' W 10°-30'-10" N
STAKE
STAKE
STAKE
MONUMENT
101.05' N 10°-30'-10" E
100.00' N 10°-30'-10" E
N
75
76
77
OAK
OAK
MAPLE
PINE
CESSPOOL
FIN. 1st FL. EL. 78.9'
60'0"
15'0"
46'0"
31'0"
28'0"
76.65'
98.05' W 10°-30'-10" N
130.25'
GREEN LANE
OAKDALE ROAD
+ EL 74.6' ℄ OF ROAD
SCALE 1" = 20'0"

INSTRUCTIONAL CODE NO. 1

Communications

WORLD OF WORK
ATTITUDE DEVELOPMENT
Instructional Code 1.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic job requirements	Demonstrate: 1. Regular attendance 2. Neat personal appearance 3. Ability to follow instructions 4. Loyalty 5. Adherence to rules 6. Satisfactory performance of assigned tasks	Relate school attendance and disciplinary factors to work–publicize absenteeism.
Attitudes which promote acceptance by fellow workers	Demonstrate: 1. Ability to work with any individual in class 2. Respect for others 3. Loyalty to others 4. Willingness to accept and appreciate help from others	Arbitrarily divide students into pairs and evaluate performance.
Methods for improving knowledge and skills	Demonstrate: 1. Craftsman's desire for perfection in all things 2. Willingness to correct mistakes–redo jobs if necessary 3. Ability to accept constructive criticism	Publish standards expected and hold to them.

CONSTRUCTION INDUSTRY–BASIC CONCEPTS
WORKER RESPONSIBILITY
Instructional Code 1.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Responsibility of worker to: 1. Employer 2. Supervisor 3. Fellow workers 4. Labor force 5. Government	Relate school and work responsibilities and determine need for functions. Analyze the responsibility factors that apply to each category.	Panel discussions Appropriate guest speakers Debates
Basic rights and responsibilities of all workers	Categorize the rights and responsibilities of all students in the lab environment and relate them to various types of jobs.	
Employer requirements	Demonstrate: 1. Loyalty 2. Proper care of tools and equipment 3. Regular attendance 4. Ability to follow orders	

CONSTRUCTION INDUSTRY—BASIC CONCEPTS
COMPARATIVE ANALYSIS OF TRADES
Instructional Code 1.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Trades involved in building construction and nature of each	Describe the basic tasks of each of the construction trades: Carpenter Brick mason Cement mason Plasterer Plumber Electrician Laborer Roofer Painter Floor and tile setter Glazier Iron worker Welder Steam fitter Pipe coverer Hoisting engineer	"Opportunities for You" publication by Oregon Building Congress (Apprentice Brochure Committee) Prepare tables showing trades and job descriptions Guest speakers Field trips Panel discussions Compare various trades in relation to working conditions, salary, training, future employment prospects, etc.

CONSTRUCTION INDUSTRY–BASIC CONCEPTS
SEQUENCE OF CONSTRUCTION
Instructional Code 1.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
The usual sequence of participation by the various trades in building construction Factors involved in determining sequence of operations	From plans and specification, assign priorities to each task and list the logical sequence for construction procedures.	From a typical set of plans and specifications, have students practice preparing lists of activities required, and from this establishing possible sequences. From field trips and consultations with contractors' representatives, have students determine usual working sequence. Debate the proper sequence of work not dependent upon completion of other steps in the building process for scheduling; i.e., painter vs floor coverer: Who is first?

CONSTRUCTION INDUSTRY–BASIC CONCEPTS
PAY–BASIS, TRADES DIFFERENTIAL
Instructional Code 1.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Pay scale for journeymen mechanics for all principal construction crafts Basis for pay differential of the principal crafts	Determine and report factors that influence pay differential, such as: 1. Percentage of time that each craft participates in a typical operation 2. Expected time loss per year due to weather conditions (by trade) 3. Differences in skills and education required 4. Economic conditions, union contract dates, etc.	From the trades listed in the trades analysis (1.21) prepare lists of pay scales. Interview persons involved in establishing pay scales, such as union representatives, contractors, negotiators, etc. Develop charts showing this portion of the analysis of trades. Attend meetings of organized labor, contractors, etc.

CONSTRUCTION INDUSTRY–BASIC CONCEPTS RELATIONSHIPS–WORKER AND SUPERVISOR, CONTRACTOR, ARCHITECT, OWNER

Instructional Code 1.24

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
The responsibilities of each category of personnel involved in construction	Explain how the functions of those responsible for construction relate to each other.	Use field trips, guest speakers, research.
The interrelationship of each category of personnel involved in construction	Supervisor: 1. Immediate supervisor 2. Designates work tasks and organization	Organize student work force to include all of those listed in the consummation of a project. Set up situations requiring action from various parties.
	Contractor: 1. Hires and fires 2. Schedules work, trades, and men	
	Architect: 1. Owner's technical representative 2. Designer–interpreter	
	Owner: 1. Pays all costs of construction 2. Selects architect and contractor	

CONSTRUCTION INDUSTRY–BASIC CONCEPTS
ROLE OF ORGANIZED LABOR
Instructional Code 1.25

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
A worker's relationship to the: 1. Organized labor force 2. Local craft union 3. Affiliated unions of other crafts 4. Job steward	Explain implications of contractor-labor agreement: 1. Only paid up members of craft unions to be employed 2. Agrees to abide by union rules and standards 3. Authorized representative to have job access List the functions of units of organized labor: 1. National organizations set craft standards, employee categories, entry requirements, training procedures. 2. Local craft unions operate hiring halls and pools of men, handle local grievances (representing members), negotiate working standards and conditions 3. Work stewards verify union membership, supervise working conditions, and represent their local unions	Take field trips; invite guest speakers (labor representatives). Develop tables of functions of various labor organizations. Debate advantages and disadvantages of organized labor on construction projects.

CONSTRUCTION INDUSTRY–BASIC CONCEPTS
APPRENTICESHIP–ORGANIZATION AND PROGRAM
Instructional Code 1.26

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Organization and responsibilities of apprentice training: 1. Federal laws 2. Union responsibility 3. Management responsibility 4. Trainee rights and obligations	List procedure for applying for apprentice enrollment–all trades. List, for each construction craft: 1. Period of indenture 2. Pay scale 3. Enrollment qualifications 4. Training program and schedule 5. Requirements for satisfactory participation	Invite guest speakers; arrange panel discussions by apprentice coordinators, administrators, teachers. Articulate secondary school program with local apprentice schools. Post apprenticeship brochures and posters. Actively assist in apprenticeship enrollment.

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Precautions for safe job performance under adverse conditions	Effectively: 1. Climb ladders, scaffolds, etc., carrying tools and materials 2. Work off the ground using ladders, staging, scaffolding 3. Work in confined spaces and in various positions 4. Work safely while under high or adverse conditions to self and others 5. Work in all sorts of climatic conditions 6. Safely and continuously carry heavy loads	Arrange field trips to construction sites during adverse weather and to high rise construction projects. Using appropriate protective clothing do some school projects during inclement weather.

CONSTRUCTION INDUSTRY—BASIC CONCEPTS
LEADERSHIP STANDARDS AND PERSONAL DEVELOPMENT
Instructional Code 1.28

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Local youth organizations that are designed to develop leadership and personal development How and why the VICA organization came into being What benefits may be derived from active VICA or other organizational membership The organizational structure of the VICA at the local, state, and national levels The relationship between the VICA and vocational programs The duties and responsibilities of VICA members and officers The types of VICA awards and their requirements Self-confidence is developed through successful participation in worthwhile activities How participation in vocational and VICA activities relates to achieving personal goals	Participate as an informed member of the VICA Participate in civic affairs as an informed member of the community	Use advisors and officers of other organizations as resource people to discuss their organizations. Use printed material from other organizations as a guide to their aims and objectives. Use chapter and/or state VICA officers, alumni, and award winners as resource people. Attend banquets, conventions, fairs, and other VICA activities. Read and discuss parts of the Official VICA Manual.

Instructional Code 1.28
(Continued)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Effect of past experience on the way people interpret what they see and hear How to improve verbal and written communication Steps in planning and conducting a demonstration Types of speeches and the purpose for which each is used Essentials for developing and delivering a speech How communication may be enhanced through acceptable appearance How to evaluate speeches and demonstrations for effectiveness	Communicate with meaning and clarity. Present and expand personal views logically and concisely to individuals or groups. Plan, organize, write, deliver, and evaluate a speech on an agricultural subject. Evaluate communications and take appropriate action.	Plan and deliver a nomination or acceptance speech. Demonstrate a shop practice to a school or civic group. Express personal views during class discussions, in a committee meeting, in a business meeting. Report on a VICA activity at the annual banquet or awards program. Introduce a guest or guest speaker at a meeting.

Instructional Code 1.28
(Continued)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
The basic differences between the democratic and the autocratic forms of government The basic characteristics of leadership How leadership is developed The influence of group dynamics and how people work together in our society The purpose and use of parliamentary procedure The rights and responsibilities of members in an organization The relationship between attitude and conduct Acceptable conduct in relation to self, others, school, personal and public property, and work	Use correct parliamentary procedure to participate in making a decision. Organize and develop an agenda for a business meeting. Chair an orderly business meeting. Accept responsibility and carry assignment through to completion. Contribute to the function of a committee. Demonstrate good personal habits in speech, manners, cleanliness, and work. Use basic etiquette for common occasions. Get along with others: 1. Maintain open lines of communication 2. Listen to others and try to understand differing point of view 3. Give credit where credit is due 4. Admit mistakes 5. Accept others as they are, with their strengths and weaknesses	Have each student serve as a group leader in a class discussion. Allow each student to serve as chairman of mock meeting. Elect officers of each construction class. Participate in parliamentary contests. Make a list of student or political leaders and define the characteristics that make them leaders. Have each student serve as member of a VICA or other organization committee. Have each student serve on a program or work committee.

Instructional Code 1.28
(Continued)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
The importance of accepting personal responsibility and respecting the rights of others The essentials of good citizenship: 1. Honesty 2. Loyalty 3. Respect for authority 4. Willingness to learn 5. Responsibility 6. Cooperation		

WRITTEN COMMUNICATIONS
PLANS READING
Instructional Code 1.31

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
How to read various types of drawings: 1. Plan views 2. Sections 3. Elevations 4. Details	Use typical house plans to: 1. Obtain dimensions 2. Determine shapes 3. Determine locations 4. Determine construction materials 5. Prepare materials lists	Complete workbook (*Building Trades Blueprint Reading & Sketching*). Use working drawing for school and student projects. Obtain "Plan Service" types of drawings and study for specific problems.

WRITTEN COMMUNICATIONS
SPECIFICATIONS
Instructional Code 1.32

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Reasons for and function of specifications	Read specifications: 1. Interpret index and organization to find specific detailed information.	Develop and publish sets of specifications for school and student projects.
How to read specifications	2. Determine grades and types of materials and fixtures. 3. Determine minimum standards of labor and materials expected. 4. Relate specific information to working drawings.	Have students practice using plans and specifications to extract specific required information. Collect and study manufacturers' specifications of building related materials.

WRITTEN COMMUNICATIONS
SYMBOLS–BUILDING TRADES
Instructional Code 1.33

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Meaning of plan symbols	Use working drawings to: 1. Determine materials and finishes 2. Determine location, type and size of openings 3. Determine location of walls and partitions 4. Determine location, size of fixtures 5. Identify electrical symbols 6. Determine air and liquid flow 7. Prepare sketches and simple drawings using appropriate symbols	Post charts of plans symbols throughout shop area. Set up exercises in which some teams prepare symbolic sketches and other teams interpret them. Use symbols in drawing student and school projects.

WRITTEN COMMUNICATIONS
SKETCHING
Instructional Code 1.34

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Uses of sketching for communication	Produce an understandable and scaled isometric sketch of a single regular shape. Produce understandable and scaled views of irregular shapes: Top view Front view End view Use a sketch prepared by others to prepare a layout and complete a building project. Draw simple sketches as necessary to clarify details.	Complete workbook *Building Trades Blueprint Reading and Sketching.* Require accurate and scaled sketches to clarify student projects.

WRITTEN COMMUNICATIONS
SCHEDULES–PREPARATION, USE
Instructional Code 1.35

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Purpose of work schedules:	Explain the purpose of schedules:	Require schedules for school and student projects.
1. Sequence	1. Logical work sequence	
2. Time	2. Time and weather	Develop schedules for theoretical projects.
3. Limitations	3. Material procurement and storage	
	4. Preserving and finishing	Invite an architect to discuss the need for scheduling work.
How to prepare job schedules	5. Owners' needs	
	6. Total completion	
	Prepare simple schedules for specific jobs or tasks.	
	Interpret plans schedules:	
	Windows from window schedule	
	Doors from door schedule	
	Finish materials from finish schedule	

WRITTEN COMMUNICATIONS
DIAGRAMS, SCHEMATICS
Instructional Code 1.36

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
How to read and follow diagrams	Interpret scope and schematic or simple diagrams. Interpret limitations of diagrams. Read and visualize installation, assembly, circuitry diagrams published by manufacturers. Read and interpret symbolic entries on diagrams.	Use manufacturers' diagrams as teaching aids--blow up, discuss, follow. Prepare simple schematic diagrams using approved symbols.

WRITTEN COMMUNICATIONS
WORK ORDERS
Instructional Code 1.37

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Preparation and use of work orders	Demonstrate the proper use of work orders: 1. When detailed instruction must be in writing to insure understanding 2. When coordination with others requires common instructions 3. To insure effective communication Carry out a work order under the conditions specified.	Prepare work orders for school and student projects. Arrange field trips to installations that normally use work orders: 1. Cabinet shops 2. Electric shops 3. Specialty trades

WRITTEN COMMUNICATIONS
READING–UNDERSTANDING WRITTEN INSTRUCTIONS
Instructional Code 1.38 (Related Codes: 1.31, 1.32, 1.35, 1.37)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Technical language and symbols of: 1. Specifications 2. Work orders 3. Plans schedules and instructions 4. Manufacturers' instructions	Use construction specifications and plans instructions to: 1. Interpret standards expected 2. Select materials and equipment Use work orders to: 1. Carry out instructions 2. Coordinate work effectively	Use specifications and work orders in school and student projects. Use manufacturers' manuals and literature as project texts. Carry out student projects without discussion to test comprehension of written instructions.

WRITTEN COMMUNICATIONS
WRITING–MATERIALS REQUIREMENTS
Instructional Code 1.39

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Use of written communications	From plans and specs: Develop and prepare material needs for a specific trade and task. Use the correct format for a written letter. Keep work reports, including: 1. Time information 2. Progress reports 3. Accident or incident reports	Simulate an incident or accident and have student prepare written reports. Have students prepare letters of application for employment. Prepare materials and supplies lists for specific school projects.

ORAL COMMUNICATIONS
GETTING A JOB
Instructional Code 1.41

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Procedures for obtaining a job in the construction trades	Explain local hiring procedures and practices for specific trades.	Stage job interviews with students and evaluate student performances.
Restrictions on hiring that relate to labor affiliations and practices, hiring hall procedures, etc.	Demonstrate acceptable job interview behavior, as indicated by: 1. Appearance 2. Positive attitudes about work 3. Honest, self-assessment 4. Knowledge of prospective employer's requirements	Visit personnel departments of large contracting firms. Guest speakers. Visit to hiring halls.

ORAL COMMUNICATIONS
FOLLOWING ORAL INSTRUCTIONS
Instructional Code 1.42

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Use of oral communications in the construction industry	Follow oral instructions to complete a specific task, using specified procedures and tools. Give oral instructions which are: 1. Simple 2. Direct 3. Clear 4. Understood by all listeners	Have students practice following oral instructions. Evaluate.

ORAL COMMUNICATIONS
LANGUAGE–TERMS, DEFINITIONS
Instructional Code 1.43

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Trade language and terms	Understand spoken or written terms and phrases peculiar to construction trades, such as the names of: 1. Tools 2. Materials 3. Practices and procedures	Maintain up-to-date glossary of pertinent terms. Furnish glossary to related academic departments (English, social studies, etc.). Insist upon correct term usage in *all* shop activities.

RELATED MATHEMATICS
BASIC ARITHMETIC
Instructional Code 1.51

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic arithmetic: 1. Addition 2. Subtraction 3. Multiplication 4. Division	Arrange a list of four two- to four-digit numbers in sequences; add them correctly. Find the differences between two whole numbers with from two to six numerals in each. Find the product of two whole numbers with from two to six numerals in each. Find the quotient of two whole numbers with from two to six numerals in each.	Related math unit workbook, such as *Basic Math Simplified*, published in vocational trades.

RELATED MATHEMATICS
FRACTIONS
Instructional Code 1.52

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Application of fractions in measurement and layout of building construction, including: 1. Reducing 2. Addition 3. Subtraction 4. Multiplication 5. Division	Reduce simple fractions to lowest terms. Reduce two or more simple fractions with a denominator of 16 or larger to a least common denominator and find the sum, expressed as a fraction. Reduce two simple fractions to a least common denominator and find the difference, expressed as a fraction. Find the product and quotient of two simple fractions, expressed as fractions.	Related math unit workbook, such as *Basic Math Simplified*, published in vocational trades.

RELATED MATHEMATICS
DECIMALS
Instructional Code 1.53

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic arithmetic of decimal fractions	Read and write decimals. Add and subtract decimals. Multiply and divide decimals.	Related math unit workbook, such as *Basic Math Simplified*, published in vocational trades.

RELATED MATHEMATICS
MEASUREMENT
Instructional Code 1.54

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic units of measure: 1. Linear 2. Area 3. Volume	Apply *direct* linear measurement, accurate to 1/16 of an inch, using standard construction measuring tools. Compute the surface area of common shapes: 1. Square 2. Rectangle 3. Triangle 4. Parallelogram 5. Trapezoid 6. Circle Compute the volume of solid shapes: 1. Cube 2. Rectangular solid 3. Cylinder	Related math unit workbook, such as *Basic Math Simplified*, published in vocational trades.

RELATED MATHEMATICS
RATIO–PROPORTION
Instructional Code 1.55

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Application of ratio and proportion in solving relationship problems such as: 1. Gear & pulley ratios 2. Roof pitch 3. Scale of drawings 4. Capacity and weights	Determine like quantities; compare two quantities; and reduce ratio to lowest terms. Translate two ratios representing equal or similar quantities into a proportion; solve for missing numbers.	Related math unit workbook, such as *Basic Math Simplified*, published in vocational trades.

RELATED MATHEMATICS
POWERS AND ROOTS
Instructional Code 1.56

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Application of exponents to typical construction problems: 1. Area of circles 2. Area of squares 3. Volume of cube 4. Volume of cylinder Application of radicals to typical construction problems: 1. Braces 2. Rafters 3. Stairs 4. Testing for square	Correctly multiply a given whole number containing from one to three numerals to the second and third power. Apply the Pythagorean Theorem and the 3-4-5 rule using any common multiples. Extract the square root of a whole number of from one to three numerals, correct to the nearest hundredth.	Related math unit workbook, such as *Basic Math Simplified*, published in various vocational trades. Prove the 3-4-5 triangulation rule and use every opportunity to apply it, using multiples.

RELATED MATHEMATICS
APPLIED GEOMETRY
Instructional Code 1.57

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic geometry	Construct a straight line between two given points using normal layout tools. Construct curved lines or circle using compass or trammel points. Construct a line parallel to a given line using compass or trammel points. Divide a line into any given number of equal parts using compass. Erect a perpendicular at any given point to a given line. Construct 3-, 4-, and 6-sided polygons using compass.	Related math unit workbook, such as *Basic Math Simplified*, published in various vocational trades.

CONSTRUCTION STANDARDS
CONSTRUCTION CODES
Instructional Code 1.61

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Local construction and specialty codes.	Explain local construction codes as they apply to construction trades. 1. Purpose–spirit and intent 2. Enforcement 3. Need for 4. Scope 5. Trades and activities covered 6. Application 7. Inspections	Obtain copies of pertinent codes for shop library; use in planning projects. Arrange class visits to local planning and building bureau offices. Panel discussions of codes: 1. Architect 2. Engineer 3. Builder 4. Planner

INSTRUCTIONAL MATERIALS

1.1 THE WORLD OF WORK*

1.11 Attitude Development

Disorderly Worker. 16mm motion picture, color, 7 minutes, (1969), $4.50 rental. The disorderly worker as a problem personality to himself and others in a work situation. Open ended. Audiovisual Instruction, Corvallis, Oregon.

Hothead. 16mm motion picture, color, 7 minutes, (1969), $4.50 rental. The hothead as a problem personality to the morale and safety of others in a work situation. Open ended. Audiovisual Instruction, Corvallis, Oregon.

1.2 BUILDING CONSTRUCTION

1.21 Comparative Analysis of Trades

Build a Better Life. 16mm motion picture, color, 13 minutes, free loan or purchase $35. Examines the experiences of young men beginning their careers in the construction industry. They give a stimulating inside view of the rewards of building, and the satisfaction of creating a better life for their communities and themselves. Modern Talking Pictures Service.

Jobs in the Sheet Metal Trades. 16mm motion picture, color, 10 minutes, (1970), $4.50 rental. The many job opportunities open to sheet metal workers. Audiovisual Instruction, Corvallis, Oregon.

Filmstrip

Hands to Build America. Sound filmstrip (74 slides and tape), color, 11 minutes, loan or purchase for $55. Designed to encourage youth to choose and prepare for building trade vocations. Modern Talking Pictures Service.

1.25 The Role of Organized Labor

Growth of the Labor Movement. Sound filmstrip, color, 33 1/3 record, 12 minutes, $39. History and growth of the labor movement in the United States. Harcourt, Brace,& J.

1.26 Apprenticeship–Organization & Program

The Apprentice. 16mm motion picture, color, 12 minutes, loan. The role of the apprentice is explained in this film. Oregon Apprenticeship & Training.

Bridges to Skills. 16mm motion picture, color, 21 minutes, loan. The apprenticeship program in Oregon. U.S. Department of Labor, Bureau of Apprenticeship & Training, Portland Area Office.

Careers in Carpentry. 16mm motion picture, color, 25 minutes, loan. Coordinator for Oregon, S.W. Washington, Carpenters, Employers, Apprentices Trust.

It's Up to You. 16mm motion picture, color, 14 minutes, loan. Promotes the idea of good school and work habits for the prospective apprentice. Oregon Apprenticeship & Training.

Skills of Tomorrow. 16mm motion picture, color, 8 minutes, loan. Film on apprenticeship. Serina Press.

Training Programs Under MDTA Programs. 16mm motion picture, color, (1970), loan. Serina Press.

1.5 RELATED MATHEMATICS

1.51 Basic Arithmetic

General Mathematics Series. Filmstrip, color, set of six, $45. Bomar Company. 1) Using Approximations; 2) Scale Drawing; 3) Saying It in Algebra; 4) The Metric System; 5) Trigonometry; 6) Measurement with Dials, Calipers, and Micrometers.

Using Mathematics 7 & 8 Series: Set I (7th & 8th grade mathematics). Filmstrip, color, set of six, $45. Bomar Company. 1) Operation with Decimals, 2) Percent, 3) Area, 4) Volume, 5) Plane Figures, 6) Constructions with Compass.

Using Mathematics 7 & 8 Series: Set II (7th & 8th grade mathematics). Filmstrip, color, set of six, $45. Bomar Company. 1) Operation with Fractions, 2) Our Decimal Number System, 3) Using the Protractor, 4) Ratio & Proportion, 5) Probability, 6) Number Bases Other than Ten.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

1.53 Decimals

Using and Understanding Numbers–Decimals and Measurements. Filmstrip, color, set of seven, $34.65 or $5.50 each. Society for Visual Education. 1) Meaning and Reading of Decimals (43 frames), 2) Addition and Subtraction of Decimals (50 frames), 3) Multiplication of Decimals (50 frames), 4) Division of Decimals (57 frames), 5) Changing Fractions to Decimals–Decimals to Fractions (54 frames), 6) Advancing in Linear Measurements (45 frames), 7) Advancing in Quantity Measurements (54 frames).

1.55 Ratio–Proportion

Proportion at Work. 16mm motion picture, color, 12 minutes, (1960), $6.50 rental. The use of ratio and proportion as practical tools for solving problems by direct measurement. Audiovisual Instruction.

Ratio and Proportion in Mathematics. 16mm motion picture, 11 minutes, (1961), $3.75 rental. Ratios as pure numbers; how to figure simple ratios, proportions, means and extremes, cross multiplying. Audiovisual Instruction.

1.57 Applied Geometry

Angles and Their Measurement. 16mm motion picture, color, 11 minutes, (1970), $130. Coronet Films.

1.6 CONSTRUCTION STANDARDS

1.61 Construction Codes

Plans Approved. 16mm motion picture, color, 27 minutes, loan. Explains the importance of building codes and the role of building officials. Traces code history from ancient times. American Plywood Association.

Filmstrip

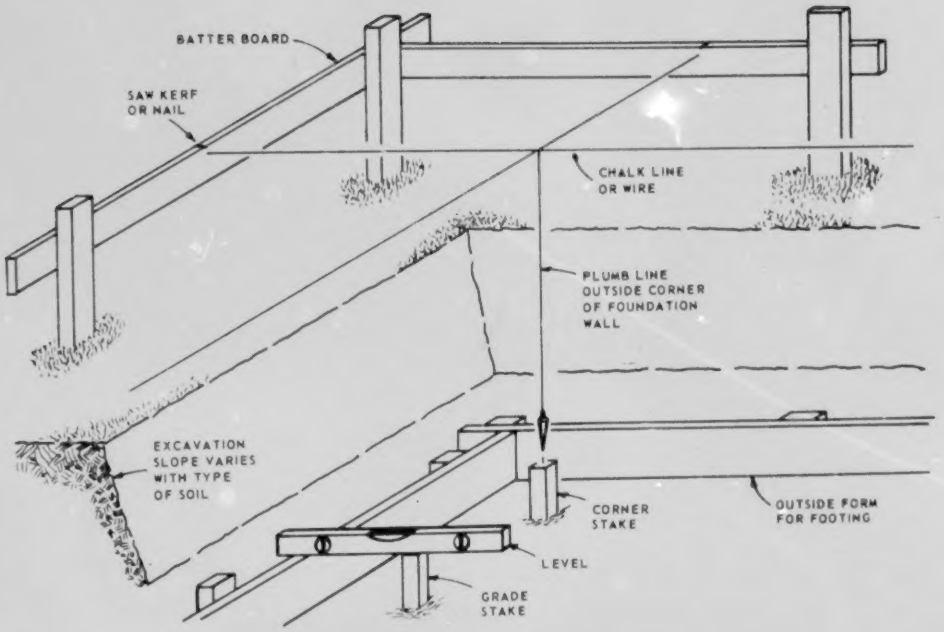
The ABC's of Building Codes. Sound filmstrip, color, LP record, 13 minutes, (1960), loan or purchase for $15. National Association of Home Builders.

Transparency

Foundation Depths Required by Codes. Transparency, $2.75. GAF Reprographic.

Slide

Windstorm Resistant Construction for your Home. No. C-137. Mounted slide set (45 frames), (1967), $8. (filmstrip, $5.50). Prospective homeowners and builders may familiarize themselves with the types of failures that take place in a building when subjected to high winds from cyclones, hurricanes, or tornadoes. This presentation illustrates how damage can be minimized by improved structural construction methods. U.S. Department of Agriculture.


BATTER BOARD
SAW KERF OR NAIL
CHALK LINE OR WIRE
PLUMB LINE OUTSIDE CORNER OF FOUNDATION WALL
EXCAVATION SLOPE VARIES WITH TYPE OF SOIL
CORNER STAKE
OUTSIDE FORM FOR FOOTING
LEVEL
GRADE STAKE

INSTRUCTIONAL CODE NO. 2

Layout

GENERAL APPLICATIONS
SURVEYING–SITE & BUILDING LAYOUT
Instructional Code 2.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Uses of conventional types of survey instruments: 1. Builder's level 2. Transit Basic survey techniques: 1. Elevations 2. Horizontal angles 3. Lines & locations	Set up and level building level and transit. Determine differences in elevations in relation to a given datum point. Use and understand oral and hand signals. Read and convert elevations in feet, inches and fractions to and from feet to the nearest hundredth. Measure horizontal angles accurately to one degree. Use plans to locate and stake lot corners. Set up batter boards, lay out building lines on batter boards, and verify. Establish and set up lot and building lines for excavation, foundation, and utilities.	Set up, level, and focus a builder's level. Practice shooting and computing difference in elevation to various points in the shop area. From a given point and mark, carry the elevation completely around a building and back to starting point. Set up exercise on shop floor to measure horizontal 90-degree angles. Set up batter boards and building lines on nearby open grounds.

GENERAL APPLICATIONS
TRANSFERRING PLANS INFORMATION
Instructional Code 2.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Techniques for reading, interpreting, and transposing plan information.	Use plans to locate: 1. Structure on site 2. Framing members, openings 3. Plumbing fixtures, waste, vent and water lines 4. Electricity service, panels, outlets, wire runs 5. Chimney, fireplace, veneer walls, concrete walls, walks, steps 6. Furnace, duct work, registers, controls 7. Built-ins 8. Floor, counter, wall finishes	Prepare working drawings of an appropriate-sized structure; transfer all pertinent data to shop or other appropriate floor area. Prepare drawings of existing structures, showing framing and various installations.

TRADE APPLICATION
CARPENTRY
Instructional Code 2.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout techniques for: 1. Building lines 2. Walls and partitions 3. Framing	Use plans to set up batter boards, including: 1. Building lines 2. Offsets Lay out location of walls and partitions on subfloor. Lay out on wall and partition planes: 1. Stud spacing 2. Door and window openings 3. Corner location and construction 4. Key structural members Verify accuracy	Lay out walls and partitions from plans using chalk lines on any large surfaced area: shop floor, gym floor, playgrounds, etc. Lay out exercises using long 2 x 4's for plates and layout tools.

TRADE APPLICATION
TROWEL TRADES
Instructional Code 2.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout techniques for:		
1. Brick-block spacing 2. Brick-block courses	Use line blocks, line holders, and mason lines to establish straight lines for brick and block.	Set up line and practice dry brick and block walls, stressing accurate alignment and spacing.
3. Concrete slab elevation and thickness	Set screeds to insure a given slab thickness and desired elevation.	Set up screeds for a hypothetical slab on school grounds.
4. Plaster grounds	Set plaster grounds for desired thickness and shapes.	Arrange field trips to construction sites.

TRADE APPLICATION
PLUMBING
Instructional Code 2.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout of plumbing installations: 1. Drain and vent lines 2. Fixture connections 3. Sewer disposal 4. Hot and cold water lines	Use plans to locate the plumbing fixtures and installation in a typical partially framed house. Locate and mark the waste, vent, and water lines serving the fixtures, using manufacturers' drawings. Locate by stakes and lines the waste lines and installations for sewer disposal.	Practice using plans to lay out fixtures, waste and vent pipe locations on shop floor. Obtain and use manufacturers' installation sheets for various types of fixtures.

TRADE APPLICATION
IRON WORKING
Instructional Code 2.24

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout placement of reinforcing steel in concrete forms–floor wall, beam or column	Use plans and detail sheets to mark off on forms location and direction of various sizes and shapes of reinforcing steel. Locate ties, stirrups, etc.	Obtain drawings, detail sheets for both reinforced concrete structure and structural steel structure from local contracting, architectural, or engineering firm. Relate reading of plans to a layout problem.
Layout placement of structural steel for site storage; availability for handling final placement–columns, beams, joists, connectors, braces	Use plans and detail sheets to lay out structural steel placement: 1. Arrange off loading for storage in lifting sequence, available for hoisting. 2. Insure that erection marks and numbers are used to insure proper placement. 3. Locate and mark off bearing points for columns and horizontal members. 4. Locate and mark off for drill or cutting on steel connectors. Verify trueness of erection by use of plumb bobs, tapes, lines.	Lay out reinforcing steel on a student form project. Learn to recognize and identify the various steel structural shapes in a building. Arrange field trips to construction sites of reinforced concrete or structural steel.

TRADE APPLICATION
FLOOR LAYING
Instructional Code 2.25

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout techniques for sheet and block flooring	Set up perpendicular lines in a rectangular room area to lay square tiles with uniform borders on opposing sides.	Lay out sample floors in shop area: set up dry tile.
	Use layout tools to scribe a square tile to fit tightly to a door jamb and casing.	Scribe tile to fit to an irregular shape.
	Use heavy paper patterns to lay out sheet flooring to fit into small areas and to irregular shapes.	Lay out and cut paper patterns for theoretical sheet installation.
	Design layout to produce minimum joints and waste.	

TRADE APPLICATION
PAINTING
Instructional Code 2.26

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Techniques of painting: 1. Exteriors 2. Interior walls 3. Ceilings 4. Woodwork 5. Hardware 6. Doors 7. Windows	Determine the order of paint application in a given area. Estimate paint requirements for specific areas and jobs. Determine most suitable methods of applying of paints and the type of working platform to be used in application.	Using water soluble paints, lay out and paint specific areas.
Layout techniques for hanging wallpaper	Follow proper procedures for wallpaper application: 1. Initial plumb line near door or corner 2. Trimming to correct length prior to hanging 3. Matching paper as the pattern dictates	

TRADE APPLICATION
ROOFING
Instructional Code 2.27

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Layout techniques for various types of roofs: 1. Wood shingles 2. Asphalt shingles 3. Roll roofing 4. Built-up roofing	Use plans to demonstrate roofing layout for: 1. Shingle roofs with: Uniform spacing and design Straight lines Flashing as required Correct lap and exposure Weatherproof hips, valleys, ridges 2. Roll roofs with Proper length of materials Lap and exposure Flashing as required	On sheets of plywood, practice lay-ups for roof sections of various types, stressing layout–lines, laps, nailing, flashing.

LAYOUT TOOLS
MEASUREMENT
Instructional Code 2.31

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Standard measuring tools: 1. Rules 2. Tapes	Determine and mark off measurements to the nearest sixteenth of an inch. Determine and mark off measurements to the nearest hundredth of a foot.	Use preselected distances and marks for testing ability to read. Develop illustrations similar to the attached sheet. Verify plan distances and mark them off on a floor.

LAYOUT TOOLS
LEVELS
Instructional Code 2.32

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Proper care and use of various level tools: 1. Hand levels 2. Builders' levels 3. Line levels Techniques that assure plumb and level installation or construction	Recognize and care for various types and sizes of hand levels. Test levels for accuracy and correct adjustable tools. Identify the types of hand levels normally used in each of cluster building trades. Read level and plumb lines within 1/16 inch in the length of the level. Identify the characteristics of line level usage—weaknesses, maximum accuracy, ease of use, cost.	Develop table of tools showing sizes, construction materials, relative costs, advantages, disadvantages, and principal trade usage. Verify accuracy of tools by reverse marking. Run level lines with different groups using different tools to illustrate the advantages and disadvantages of each type. Run level lines completely around a room or perimeter to test for student accuracy.

LAYOUT TOOLS
LINES
Instructional Code 2.33

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of straight line tools normally used in building construction: 1. Mason's line	Use a chalk box to develop a straight line between two points on a plane to a distance of 50 feet.	Lay out and mark wall and partition lines from plans on the shop floor.
2. Straight edge 3. Chalk box and line	Use mason's line to establish a straight line uniformly offset at points of fastening for straight line development.	Stretch a mason's line offset from a wall and lay up one straight course of brick parallel to the line.
	Mark for cutting a straight line on a panel to fit another straight line on a panel.	Mark a straight line on an eight-foot piece of plywood; cut and fit to an adjoining piece.

LAYOUT TOOLS
SQUARES
Instructional Code 2.34

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Appropriate use, maintenance, and care of squares: 1. Framing square 2. Combination square 3. Bevel square 4. Try square	Use a combination square to lay out: 1. 90-degree cuts 2. 45-degree cuts 3. Line parallel to edge of stock Use a framing square to lay out: 1. 90-degree cuts 2. 45-degree cuts 3. Simple brace and step cuts Use a bevel square to lay out any angle between 10 and 90 degrees.	Framing square exercises from carpentry texts.

LAYOUT TOOLS
PLUMB BOB
Instructional Code 2.35

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Use of the plumb bob in establishing and testing of vertical building members	Use a plumb bob to test and correct, as necessary, a vertical member over seven feet in height.	Lay out locations for plumbing waste and vent pipes through top and bottom plates of partition using plumb bob.
Substitutes for the plumb bob	Make and use a plumb bob using materials at hand: 1. Chalk line and box 2. String and weighted object (nut, etc.)	Set up, plumb, and brace a wall or partition using plumb bob or expedient.

LAYOUT TOOLS
MARKING TOOLS
Instructional Code 2.36

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Common marking tools used in building construction: 1. Pencils a. Plain b. Carpenter 2. Crayon 3. Chalk 4. Soap stone 5. Scribe 6. Compass 7. Divider 8. Trammel points 9. Awl	Select the proper marking tools for a specific task.	Mark for cutting a floor tile to fit a door jamb and casing.
	Demonstrate the proper use and care of each tool.	Mark for cutting, bending, and fitting a sheet metal member, such as a rectangular register box.
	Mark for proper fit various building materials to be cut and fit for specific jobs.	Scribe roofing material for cutting openings for vent.

2.2 SPECIFIC TRADES APPLICATIONS*

2.21 Carpenter

The Algoma Story. 16mm motion picture, color, 27 minutes, loan. This film shows the manufacture of architectural grade plywood, for fine custom interiors of homes and public buildings. It includes demonstrations, explanations and location sequences. Indicate on your request that this film will be used by advanced industrial arts classes and architectural students only. United States Plywood Corporation.

Big River Crossing. (Bridge Construction). 16mm motion picture, color, 13 minutes (1970), loan. Serina Press.

Building Trades: The House Builder. 16mm motion picture, color, 15 minutes, (1969), $195. Universal Education and Visual Arts.

Careers in Building Trades. 16mm motion picture, 11 minutes, (1970), $130. Coronet Films.

Carpentry: Layout and Construction of a Staircase. 16mm motion picture, 13 minutes, $150. Sterling Educational Films.

Carpentry: Rafter Layout. 16mm motion picture, 13 minutes, (1968), $150. Sterling Educational Films.

Construction By 'Copter. 16mm motion picture, color, 20 minutes, loan. This film shows the helicopter in the heavy building and construction industry as a time and money-saving tool, functioning as an aerial crane. Construction applications, actually filmed on the job, include many construction projects in all parts of the country. Association Films, Inc. or Sikorsky Aircraft.

Easy Care Living. 16mm motion picture, color, 16 minutes, loan. How to best use aluminum products in homebuilding. Follows construction of residential development from planning through installation of wide variety of aluminum products. Aluminum Association.

Framing: Floor Joists and Walls. 16mm motion picture, black & white, 25 minutes, $43.75. Illustrates procedures for constructing walls, floors, doors, and windows of a two-story building. United States National Audiovisual Center.

Framing: Hip and Valley Rafters. 16mm motion picture, black & white, 25 minutes, $43.75. Shows how to cut, measure, and fit hip and valley rafters, and compares them with regular type rafters. United States National Audiovisual Center.

Framing: Rafter Principles and Common Rafters. 16mm motion picture, black & white, 15 minutes, $27. Illustrates laying out and cutting of rafters. United States National Audiovisual Center.

A Glass Door Lesson for Charlie. 16mm motion picture, color, 12 minutes, loan. While installing new sliding glass doors, average homeowner Charlie learns about different kinds of glass, (ordinary annealed, laminated, wired and tempered) and how they react to impact. The value of safety glazing his doors becomes obvious. Architectural Aluminum Manufacturers Association.

Houses Have Four Sides. 16mm motion picture, color, 30 minutes, loan. This film shows the advantages aluminum siding presents to homeowners. Job estimating, use of accessories and installation techniques are shown in detail, especially the practical economies that can be achieved. Recommended for architects, contractors, realtors, prospective homeowners and trade schools. (Sponsor request only). ALCOA.

An Idaho Sawmill. 16mm motion picture, color, 20 minutes, (1970), loan. Serina Press.

Interior and Exterior Trim. 16mm motion picture, black & white, 12 minutes, $22.25. Covers the installation of doors and windows and the finishing trim around them. United States National Audiovisual Center.

The Intruder. 16mm motion picture, color, 28½ minutes, loan. This film deals with the life and habits of subterranean termites and shows how they may be controlled. Bruce Company, Inc. or Swant Motion Pictures, Inc.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

The Japanese Carpenter. 16mm motion picture, color, 20 minutes, loan. Explores traditional woodworking techniques of the Japanese carpenter, and classic examples of his craft. California Redwoods Association.

Plywood Pallet Bins for Agriculture. 16mm motion picture, color, 18 minutes, loan. Mechanization in agricultural materials handling. Important role of plywood pallet bins in handling produce from harvest to processing. Suggestions for other industrial materials handling. American Plywood Association.

Roof Construction–The Common Rafter. 16mm motion picture, color, 12 minutes, (1969), $6.50 rental. The roof, roof members, the pitch, and common rafter layout. Advanced presentation. Audiovisual Instruction.

Safe As Houses. 16mm motion picture, color, 22 minutes, $195., or may be rented. Association Films.

The Story of the Weldwood House. 16mm motion picture, color, 26 minutes, loan. This film shows the construction of a house from start to finish. The house was designed and built by architect-builder Harry J. Quinn, of Chicago. The house utilizes the most forward thinking, tested construction techniques; yet it is a house that also has been designed from the standpoint of what people want in a home. United States Plywood Corporation.

Filmstrips

The Benefits of Building with Aluminum Windows. Sound filmstrip, color, LP record, 18 minutes, loan. Presents outstanding features and details the characteristics of numerous individual types from double hung to vertical pivot. Architectural Aluminum Manufacturers Association.

A Big View . . . and Safety Too. Sound filmstrip, color, LP record, 18 minutes, loan. History of aluminum sliding glass doors. Highlights AAMA's industry leadership in trying to effect the universal use of safety glazing in all sliding glass doors. Architectural Aluminum Manufacturers Association.

Building the Shell. Filmstrip (33 frames), color, (1969), $5. Society for Visual Education.

Constructing the Walk. Sound filmstrip (44 frames), $5. NASCO West.

Exterior Building Materials for Your Home. No. C-151. Filmstrip (43 frames), $5.50, (mounted slide set, $8.) (1968) The proper siding can give your home protection, charm, and a lot of other qualities. Choose the right siding for your home, neighborhood, and pocketbook. This presentation will help you decide. United States Department of Agriculture.

Foundations for Your Home. Filmstrip (33 frames), (1966), $5.50. United States Department of Agriculture.

Interior Building Materials for Your Home. No. C-133. Filmstrip (42 frames), $5.50 (mounted slide set, $8.) (1967) Interior building materials available for light house construction are illustrated. A wide variety of materials are discussed along with some features of installation, design, and cost that will interest homeowners and builders. United States Department of Agriculture.

Laying Out the Foundation of a Building. Filmstrip, color, (1969), $7.80. Colonial Films.

The Nation's Builders. Sound filmstrip set, (6 filmstrips and records), (1970), $36.50. Events in work day of carpenters, heavy construction, and others in the construction trade. Stanley Bomar Company.

Thermal Control with Aluminum Windows. Sound filmstrip, color, LP Record, 18 minutes, loan. Offers builders guidelines to windows and their construction. Examines and analyzes pertinent and related characteristics that must be considered such as maintenance, operatability, durability, heating and air conditioning, condensation and relative humidity. Architectural Aluminum Manufacturers Association.

What Is An Applicator Mechanic? Sound filmstrip, color, LP record, 17 minutes, loan. This film is divided into two 61 frame filmstrips. Part 1 shows the expanding opportunities in the aluminum siding field and points out the many advantages of joining this trade. Part 2 explains the application of aluminum siding, listing the tools and dealing with cutting and nailing. Recommended for high school, industrial art programs, trade schools. Architectural Aluminum Manufacturers Association.

Transparencies

Carpentry Units (Series 7). Transparencies,$224, 3M Company.

Ceiling Joists Construction. Transparencies, $3, GAF Reprographics.

Cornice Construction–Details. Transparency, $9.25, DCA Educational Products.

Door Construction. Transparency, $5.70, DCA Educational Products.

Exterior Trim. Transparencies, $35, 3M Company.

Exterior Wall Covering. Transparency, $3.75, GAF Reprographic.

Final Partitions. Transparency, $3.75, GAF Reprographic.

Finished Building. Transparency, $3, GAF Reprographic.

Footing Dimensions. Transparency, $4.75, GAF Reprographic.

Framing for Openings. Transparency, $5.75, GAF Reprographic.

House Framing–Part I. Transparencies, $35, 3M Company.

House Framing–Part II. Transparencies, $35, 3M Company.

Interior Trim. Transparencies, $35, 3M Company.

The One-Story Building. (Series 21) Transparencies, $81, GAF Reprographic.

Partitions. Transparency, $3.75, GAF Reprographic.

Plate and Joist Butts. Transparency, $3, GAF Reprographic.

Rafter Construction. Transparency, $4.25, GAF Reprographic.

Roof Framing–Part I. Transparencies, $35, 3M Company.

Roof Framing–Part II. Transparencies, $35, 3M Company.

Staircase Construction. Transparencies, $35, 3M Company.

8mm Loops

Carpenters. Super 8mm loop film, color, 3 minutes, $22. Encyclopaedia Britannica Educational Corporation.

Construction (Pts. 13). Super 8mm loop film, color, (1969), $251.88. Scope Productions, Inc.

Audio Tape Reel

Your Future as a Carpenter. Audio tape reel, $7.50. Harcourt, Brace,& J.

2.22 Trowel Trades

ABC's of Masonry Construction. 16mm motion picture, color, 10 minutes, loan. Presents the basic steps in concrete masonry wall construction. Shows the importance of corners and first course in constructing sound building walls. Illustrates the different types of masonry units and describes their uses. Most of the procedures were shot at an actual student demonstration. (1963) Modern Talking Pictures.

Art and Industry of Precast Concrete. 16mm motion picture, color, 24 minutes, (1964), loan. Shows various operations in the design, manufacture, and erection of several types of precast concrete panels. Stresses the requirements of skilled workmen, well-equipped plants, and careful attention to details. Scenes of many spectacular structures clad in concrete curtain walls are combined with scenes taken in several of the nation's large panel plants. The new role of the artist in this rapidly expanding industry is also depicted. Modern Talking Pictures.

A Bridge of Size. 16mm motion picture, color, 22 minutes, (1969), loan. A visually exciting filming on the construction of the second Lake Pontchartrain Causeway in Louisiana in 1968-69.

Starting with scenes depicting the early history of the lake, the camera moves through the casting yard, where the bridge members are constructed. Out on the lake, the progress of the bridge construction is shown through the pile driving, and cap and slab placement. Much of the film narration is by the engineers who designed and built this 28-mile long, all concrete companion to the earlier causeway built in 1956. Modern Talking Pictures.

Cast-In-Place Concrete Roof Truss System for Single-Family Homes. 16mm motion picture, color, 14 minutes, (1967), loan. An on-the-job report that tells the complete story of a unique, new concrete roof system. The system consists of concrete trusses, spaced 4 ft. oc, and a 3-inch roof deck, all monolithically cast in place. Although this roof system has been developed primarily for single-family homes, it has application for low-rise apartments and motels, commercial, industrial and agricultural buildings. Modern Talking Pictures.

Challenge of the North Santiam. 16mm motion picture, color, 29 minutes, (1955), loan. Shows construction of Detroit Dam and Big Cliff Dam from early planning stage to completion. (Located near Detroit, Oregon) United States Army Engineer Division, North Pacific.

Concept in Concrete. 16mm motion picture, color, 28½ minutes, loan. This film shows in addition to the construction of the Lake Pontchartrain Causeway, the construction of the Pensacola, Florida Causeway and the Slidell Twin Bridges Causeway on Interstate 10 in Louisiana. Ideal Cement Company.

The Concrete Arch. 16mm motion picture, color, 25 minutes, loan. This film deals with Flaming Gorge Dam construction to its halfway completion point in November, 1961. This structure is located on the Green River in northeastern Utah. It shows diverting of the river, excavating the site to bedrock, and placing one million tons of concrete. Bureau of Reclamation, Chief Engineer.

Concrete Curtain Walls. 16mm motion picture, color, 18 minutes, (1960), loan. First nationwide review of many types of buildings—from small offices to skyscrapers—that have been beautifully enclosed with precast concrete curtain walls. Various new structures from each region are shown. Special emphasis is given to the wide variety of colors, textures, sculptured and grille effects which have been developed during the short history of this amazing new building product. Modern Talking Pictures.

Concrete Example. 16mm motion picture, color, 16 minutes, (1957), loan. Shows how to obtain good concrete jobs with materials and equipment available to farmers. Shows selection of aggregates, mixing, placing, finishing, and curing concrete. Portland Cement Association.

Concrete in the Sixties—Report No. 7. 16mm motion picture, color, 20 minutes, (1966), loan. Covered in the film are 31 projects throughout the United States and Canada which depict advances in concrete design and construction. Concrete revetments are shown successfully withstanding hurricane forces along Atlantic and Guft Coast shore areas. Other scenes show thin arch dams; unusual treatment of concrete in 23 buildings for an entirely new university campus; construction details at the Gulf Life Building in Florida, tallest posttensioned building in the world; first use of slip-form paving in Canada; advances in slip-form paving in the United States; and a preview of Montreal's preparation for Expo '67. Modern Talking Pictures.

Concrete in the Sixties—Report No. 8. 16mm motion picture, color, 20 minutes, (1967), loan. The film opens with coverage of the PCA-administered federal manpower training program for cement masons and plasterers and closes with outstanding uses of sculptured concrete. Two different slip-form operations are shown; a computer-designed stadium in Tampa, Florida, is depicted; and several projects are filmed showing the new "brutalized" architectural effects achieved by sandblasting, bush-hammering and other methods. Modern Talking Pictures.

Concrete in the Sixties–Report No. 9. 16mm motion picture, color, 22 minutes, (1968), loan. Highlights of concrete design and erection techniques presented in newsreel form covering 1968. Included in the subject matter are bridges in Louisiana and Florida; the Hilton Palacio Del Rio Hotel; Low Income Housing in Wasco, California; the Hagel system of precast bents; Research VII in Washington, D.C.; UNIFRAME testing and construction and the PCA Cement and Concrete Center at Skokie, Illinois. Modern Talking Pictures.

Concrete Now–Prelude to the Seventies. 16mm motion picture, color, 21 minutes, (1969), loan. The last in the series *Concrete in the Sixties,* the yearly newsreels of accomplishments in concrete construction. This film shows the highlights of the decade 1960-69. It gives a brief pictorial and narrative review of some of the outstanding concrete construction projects in the U.S. and Canada during the past 10 years. A number of projects under way in 1969 are included. Modern Talking Pictures.

Concrete's Finest Fifty Years. 16mm motion picture, color, 32 minutes, (1966), loan. Timed to coincide with PCA's golden anniversary, this documentary film dramatizes the vital, often spectacular role of concrete in the past half century. It shows new design and construction methods, and how they evolved from rough and sometimes daring innovations. Modern Talking Pictures or Serina Press.

Constructing a Prestressed Concrete Building. 16mm motion picture, color, 11½ minutes, (1962), loan. An on-the-job report of all phases of construction of a multistory prestressed concrete parking garage. Film starts with casting members in the yard and continues with erection of precast columns, placement of lightweight floors, and the posttensioning of various column and floor units. Modern Talking Pictures.

Construction of a Concrete Industrial Floor on the Ground. 16mm motion picture, color, 32½ minutes, (1961), loan. A discussion of the requirements for a good, durable concrete floor, including base preparation, types of joints, and proper handling of quality concrete. This is followed by the step-by-step construction of a demonstration floor from subbase to cured surface. A sequence on quality control on the site and proper use of finishing equipment is included. Modern Talking Pictures.

Construction of the Little Rock Veterans Administration, Part I. 16mm motion picture, color, 43 minutes, loan. This film deals with phases of construction from the geology of the site to the completion of the penthouse. It includes the use of bar joists and pan forms, as well as the damp-proofing of concrete. United States Army Engineer District, Little Rock.

The Dalles Dam. 16mm motion picture, color, 29 minutes, (1956), loan. Shows construction progress on The Dalles Dam (The Dalles, Oregon), from project's inception to completion. U.S. Army Engineer Division, North Pacific.

Everything Under the Sun. 16mm motion picture, color, 20 minutes, (1967), loan. This film illustrates the unlimited design opportunities inherent in the use of concrete and concrete products in outdoor living areas. Shown are driveways, swimming pools, reflecting pools and pool decks, patios, large and small planters, garden and retaining walls, screen walls, fountains, and walks. The role of the landscape architect working with the builder and owner is emphasized. Modern Talking Pictures.

Foundations and Concrete. 16mm motion picture, black and white, 26 minutes, (1950), $5 rental, (purchase price $45.50 from United States National Audiovisual Center). Laying out a simple frame building, constructing the forms, and completing the concrete foundation. Audiovisual Instruction.

Futures in Concrete. 16mm motion picture, color, 14 minutes, loan. This film shows the recent construction which doubles the capacity of Ideal Cement Company's Tijeras, New Mexico plant. It emphasizes the fact that concrete is gaining flexibility through new construction techniques. Ideal Cement Company.

Heavy Duty, Two Course Floors: Principles of Quality Concrete No. 4. 16mm motion picture, color, 13½ minutes, (1967), loan. The film describes the construction of heavy duty, two course floors for factories, foundries, and other industrial and commercial buildings whose floors are subject to highly abrasive conditions. The movie illustrates the construction procedures and describes the design considerations required to secure satisfactory performance. Modern Talking Pictures.

Hidden Strength. 16mm motion picture, color, 20 minutes, loan. This film deals with cement and concrete. It describes and illustrates the many ways in which portland cement and keymesh reinforcing have been used. The Venard Organization.

Hilton Palacio Del Rio. 16mm motion picture, color, 13½ minutes, (1968), loan. The exciting construction story of the Hilton Palacio Del Rio, the 21-story "instant" hotel in San Antonio that flew into place. This on-the-job report includes scenes of the precasting and finishing operations that produced the 496 precast room units. Modern Talking Pictures.

How to Build New Shapes in Concrete. 16mm motion picture, color, 18½ minutes, (1960), loan. Film shows several methods of forming and casting thin-shell barrels, folded plates, and hyperbolic paraboloids. It includes description of movable forms for multiple-unit roofs, arrangement of reinforcement, and concrete finishing and curing. Modern Talking Pictures.

How to Make Decorative Patio Floors for Outdoor Living. 16mm motion picture, color, 19½ minutes, (1961), loan. Film shows all the required steps in producing decorative patio slabs with exposed-aggregate and colored finishes, and flagstone, incised geometric, and leaf patterns. Modern Talking Pictures or Portland Cement Association.

How to Transport, Place, Finish, and Cure Quality Concrete. 16mm motion picture, color, 32 minutes, loan. Shows placing methods in horizontal and vertical forms, proper finishing techniques, and a variety of curing methods. Portland Cement Association.

The Inside Story of Concrete. 16mm motion picture, color, 14 minutes, loan. This film, partly in animation, illustrates and describes the investigational work required for the production of high quality mass concrete. U.S. Army Engineer Waterways Experiment Station.

Knock Down Costs with Tilt-Up Buildings. 16mm motion picture, color, 10 minutes, (1970), loan. Describes a simple method of constructing tilt-up concrete farm buildings. Step-by-step procedures are presented for fabricating and erecting sandwich wall panels on small projects. The film is highly complimentary to concrete construction and will be particularly useful in presentations to agricultural builder-contractors or other farm-oriented groups. Portland Cement Association.

Meat, Milk and Money with Livestock on Concrete. 16mm motion picture, color, 15 minutes, (1956), loan. Paving of farm yards; methods of finishing. Audiovisual Instruction.

Mudjacking Concrete Pavement. 16mm motion picture, black & white, 11 minutes, (1960), $19.25. United States National Audiovisual Center.

New Dimensions in Concrete. 16mm motion picture, color, 28½ minutes, loan. This film shows the new uses and shapes of concrete in our daily living–in highways and housing, in playgrounds and pools, in commercial buildings and churches. Ideal Cement Company.

New Dimensions in Concrete–Part V. 16mm motion picture, color, 16 minutes, (1970), loan. Fifth in the *Twelve Decades of Concrete in American Architecture* series. The film carries the theme of the series through the 1960's, showing the broadening and more imaginative uses of sculptured concrete panels, executed in various molds, designed as decoration or load-bearing walls. A series of different structures designed by some of North America's leading sculptors and artists is discussed, and use of exposed aggregate and white cement highlighted. Modern Talking Pictures.

A New England Precast Building System. 16mm motion picture, color, 12 minutes, (1970), loan. Documents the growing use of standardized, prefabricated components to reduce construction time and expense. Known as systems or industrialized building, this application of mass production techniques to residential construction may well be the answer to the housing shortage that looms in the decade ahead. Construction and erection of precast components for the Fountain Head Apartments in Westboro, Massachusetts, Roxse Apartments, Boston, Massachusetts, and North Canal Apartments, Lowell, Massachusetts, are illustrated. Modern Talking Pictures.

New Horizons in Plastering. 16mm motion picture, color, 20 minutes, loan. This film shows the latest techniques in machine-applying three vermiculite products. The speed and economy of machines as materials handling tools for applying vermiculite plaster, acoustical plastic, and concrete are demonstrated on jobs ranging from small houses to skyscrapers. Vermiculite Institute.

New Shapes in Concrete. 16mm motion picture, color, 16½ minutes, (1959), loan. An exciting look at the large number and variety of shell structures–domes, barrels, folded plates and hyperbolic paraboloids–that have been erected all over America during the late 1950's. A section of the film demonstrates the principles of shell construction, and a portion is devoted to the brief but astounding history of shell design and construction all over Europe and North and South America. Modern Talking Pictures.

New, Versatile Slip-Form Paver. 16mm motion picture, color, 5 minutes, (1968), loan. An on-the-job report showing how the Easi-Pour slip-form paver was used to construct streets in Huron, S.D. A filmed introduction to a new development in slip-form paving equipment which can be used for streets, parking lots, feed lots, shoulders, driveways, and other small paving jobs. Modern Talking Pictures.

Operation Concrete. 16mm motion picture, color, 25 minutes, (1950), loan. Shows concrete operations at the Detroit Dam on the North Santiam River, near Detroit, Oregon. United States Army Engineer Division, North Pacific.

Planning and Building the Modern Farm Home. 16mm motion picture, color, 14½ minutes, (1961), loan. The development of the modern farm home and its essential features. The film displays a wide variety of concrete construction units and how they are incorporated for function and beauty in a rural dwelling. A construction sequence illustrates the hidden features of quality in building the farm house. Modern Talking Pictures.

Powder Lancing (concrete cutting). 16mm motion picture, black & white, 6 minutes, (1969), loan. Union Carbide Corporation.

Principles of Quality Concrete. 16mm motion picture, color, 40 minutes, (1966), loan. Audiovisual Instruction.

Quality Ready-Mixed Concrete. 16mm motion picture, color, 31½ minutes, (1955), loan. This is the third major film in the Quality Concrete series. It shows various plant operations involved in producing quality ready mixed concrete and the steps necessary on the part of the contractor and workmen to maintain its quality in the field to produce satisfactory jobs. Modern Talking Pictures.

Shaping the Future with Lath and Plaster. (includes the film, *Shape of the Future.*) 16mm motion picture, color, 24 minutes, loan. Demonstrates the proper application of gypsum lath and plaster. Gypsum Association.

Three Cousins (plastering). 16mm motion picture, color, 18 minutes, (1967), loan. Deals with three phases of portland cement plastering. Plaster Information Center.

This Is Marina City. 16mm motion picture, color, 18½ minutes, (1966), loan. This nontechnical film describes hour-by-hour operations in the planning, building, and use of twin circular towers permitting nearly 900 families to live at the very edge of Chicago's central business district. The design philosophy of the architect and all phases of construction, from 110 feet below ground to 600 feet above, are discussed. Modern Talking Pictures.

Tilt-Up Construction. 16mm motion picture, color, 17 minutes, (1956), loan. How current methods of tilt-up construction speed erection of all types of buildings from single-story warehouses, commercial and industrial buildings to multistory buildings. Shows layout of forms and reinforcement, a variety of inserts and handling devices, how to produce decorative detail, several types of bond breakers, panel curing and lifting methods. Modern Talking Pictures.

Tilt-Up Construction on the Farm. 16mm motion picture, color, 16 minutes, (1963), loan. Shows step-by-step methods of tilt-up concrete construction of various structures for agricultural uses. Portland Cement Association.

Total Concept in Warehousing. 16mm motion picture, color, 12 minutes, (1970), loan. A highly promotional presentation on the uses of concrete for modern warehouses. The drab warehouse of the past can be replaced by an attractive building using total concrete construction. Shown are many examples of new designs in concrete warehouses that are sturdy, spacious, sanitary, and attractive. Originally a part of the Southeastern Region's Seminar on Warehouse and Industrial Buildings, the film has been revised for general use throughout the United States. Modern Talking Pictures.

Twelve Decades of Concrete in American Architecture: Part I, The Long Years of Experiment (1844-1920). 16mm motion picture, color, 16½ minutes, (1965), loan. The film shows the use of concrete in buildings by the farmers, mechanics, and inventors who were largely responsible for major developments in concrete as an architectural and structural material during the period of 1844-1920. Modern Talking Pictures.

Uniframe–Newest Idea in "Predesigned" Structures. 16mm motion picture, color, 9 minutes, (1970), loan. An introduction to PCA's new precast, rigid-frame building design. The film discusses the UNIFRAME design concepts, shows fire and structural testing in the laboratory, and illustrates the fabrication and erection of the precast components into a completed structure. Many examples of UNIFRAME buildings in the United States and Canada are shown, with emphasis on the variety of uses and occupancies to which the design can be put. Modern Talking Pictures.

Filmstrips

Laying Concrete Masonry Units. Sound filmstrip (54 frames), color, LP record, (1969), $1.37. NASCO West.

Laying Out Foundations of a Building. Sound filmstrip (79 frames), color, LP record, (1969), $6. NASCO West.

Let's Make Concrete. Sound filmstrip (75 frames), color, LP record, $2.50. NASCO West.

Planning and Preparing For Concrete Masonry Construction. Sound filmstrip, (63 frames), color, LP record, (1969), $1.55. NASCO West.

Special Concrete Masonry Problems. Sound filmstrip (53 frames), color, LP record, (1969), $1.30. NASCO West.

Transparencies

Application of Stone Veneer. Transparency, $4.50, GAF Reprographic.

Concrete Block Construction. Transparency, $3.75, GAF Reprographic.

Pouring the Footing. Transparency, $4.25, GAF Reprographic.

Preliminary Steps for Excavation. Transparency, $6.50, GAF Reprographic.

8mm Loops

Bricklayers. Super 8mm loop film, color, 3 minutes, $22. Encyclopaedia Britannica Educational Corporation.

Cement Masons. Super 8mm loop film, color, 3 minutes, $22. (1969). Encyclopaedia Britannica Educational Corporation.

Slides

Foundations For Your Home. No. C-131. Mounted slide set (33 frames), set $8. (filmstrip, $5.50) (1966). A presentation intended to familiarize prospective homeowners and builders with the importance of adequate foundations in light house construction. Various types of foundations and their relative merits when utilized for specific types of construction are discussed. United States Department of Agriculture.

Publications

American Concrete Institute Publications. 25 pages, free. Listing of many booklets on concrete practices. American Concrete Institute.

Concrete Form Construction. 166 pages, saddle stitched, school price, $1.56. This text covers the theory and practice in layout and construction of different shaped concrete forms for frame buildings. Delmar Publishing Company, Inc.

Design of Wood Formwork for Concrete Structures. 20 pages, 8½ x 11 inches, 2 colors, 25 cents. Current information on using structural lumber and boards in formwork construction. Technical Service Division.

Manual of Gypsum Lathing and Plastering. (1970), 65 cents. Gypsum Association.

Manual of Lathing and Plastering. 366 pages, $1.75. Gypsum Association.

2.23 Plumber

By Any Other Name. 16mm motion picture, color, 11½ minutes, loan. This film is a humorous treatment of a delicate subject—the removal of foul air from bathrooms by means of the Vent-Away, a device manufactured by American-Standard and incorporated in their water closet fixture. The use of Chuck McCann puppets make the story suitable for any group. American-Standard Plumbing and Heating Division.

A Drink For Judy. 16mm motion picture, color, 13½ minutes, loan. This film illustrates and discusses proper installation of plumbing. It gives excellent explanation of back-siphonage in simple everyday language, and includes demonstrations. National Association of Plumbing-Heating-Cooling Contractors.

The Heat's On. 16mm motion picture, color, 10 minutes, loan. This film presents a version of the Hot Water Heating Puppet Show as it appeared at a building show in Chicago. This humorous puppet treatment points out the many advantages of hot water heat over other types, from the viewpoint of the building contractor as well as the homeowner. American-Standard Plumbing and Heating Division.

Permaglas Does It Again. 16mm motion picture, color, 33 minutes, loan. This film features "Permaglas" water heaters, showing interesting research scenes at the Milwaukee plant and manufacturing operations at the Kankakee plant. A skeptical customer is sold on the value of Permaglas water heaters. Smith Corporation.

Pipe For Progress. 16mm motion picture, color, 15 minutes, (1962), loan. American Iron and Steel Institute.

Plumbing: Plumbing Joints. 16mm motion picture, color, 13 minutes, $150. Sterling Educational Films.

Plumbing: Traps and Vents. 16mm motion picture, color, 13 minutes, (1968), $150. Sterling Educational Films.

8mm Loop

Plumbers and Pipefitters. Super 8mm loop film, color, 3 minutes, (1969), $22. Encyclopaedia Britannica Educational Corporation.

Audio Tape Reel

Interview, Plumber-Pipefitter. Audio tape reel, (1969), $5.50. Imperial International Learning.

Publication

Your Future In Plumbing, Heating and Cooling. Free. Booklet is well illustrated and in question-answer format. National Association of Plumbing-Heating-Cooling Contractors.

2.24 Iron Worker

How To Rivet Aluminum. 16mm motion picture, black and white, 27 minutes, (1966), loan. This film shows the making and testing of rivets, the preparation of the work and the actual riveting. It discusses the alloys commonly used in rivets, how rivets are driven and the proper methods of using heat treated rivets. ALCOA.

Rain-Carrying Equipment. 16mm motion picture, color, 21 minutes, loan. This film describes the fabrication and installation procedures for aluminum rain-carrying equipment. It traces a typical job from shop work to final installation on the site and offers valuable pointers on the use of systems and flashings. Association Films, Incorporated.

Slide

Heating and Cooling Your Home. No. C-130. Mounted slide set (52 frames), $9 (filmstrip, $6.50) (1967). A presentation to familiarize builders and prospective homeowners with the types of heating and cooling systems available and some of the advantages and disadvantages of each. U.S. Department of Agriculture.

Audio Tape Reel

Your Future as a Sheet Metal Worker. Audio tape reel (1 reel), 1961, $7.50. Harcourt, Brace, & J.

2.25 Floor Layer

Flooring Craftsman. 16mm motion picture, color, 15 minutes, (1969), loan. Armstrong Cork Company.

Floors With a Future. 16mm motion picture, color, 23 minutes, loan. This film presents proper floor installation techniques. A floor mechanic demonstrates these techniques for strip hardwood flooring and block hardwood flooring in both conventional and concrete slab construction. It includes a brief sequence on the manufacture and factory-finishing of flooring. Bruce Company, Incorporated.

Transparency

Flooring Construction (Sub-Floor), Transparency, $3.75, GAF Reprographic.

Publication

1969 Handbook of Ceramic Tile Installation. 20 cents. Tile Council of America.

2.26 Painter

College of Roller Knowledge. 16mm motion picture, color, 18 minutes, loan. It illustrates and explains the technological properties of paint roller construction and application. E-Z Paintr Corporation.

Color Harmony for Your Homes. 16mm motion picture, color, 20 minutes, loan. Shows use of color in decorating homes. How to create monochromatic related, or contrasting color schemes, how to build a complete color scheme from beginning to end. Brooklyn Paint and Varnish Company.

Corrosion. 16mm motion picture, color, 24 minutes, loan. This film, narrated by Chet Huntley, discusses corrosion, its causes, effects and cures and is available from The Glidden Company.

It's the Same Story–With a Difference. 16mm motion picture, color, 20 minutes, loan. Directed to paint shop operators and painters; covers spot repair techniques for both lacquer and enamel topcoats. Also discusses the advantages of new "Dulux (R)" enamel, and reviews matching of metallics. du Pont.

Light in the Dark. 16mm motion picture, color, loan. This film, starring George Montgomery, dramatizes the many operational and promotional problems faced by the professional painting contractor. The Glidden Company.

Maintenance. 16mm motion picture, color, 30 minutes, loan. This film covers the seven problems of maintenance painting. The Glidden Company.

Making the Most of the Spray Painting Method. 16mm motion picture, color, 45 minutes, loan. This film shows how spray equipment works, the types of equipment and their adjustment, the elements of the spraying machines and their functions. It also shows how to use spray equipment, how to care for the equipment and the cleaning of the gun, booth, hose, and the containers. It also includes the locating and correcting of common defects. DeVilbiss Company.

The Master's Touch–Homeowners. 16mm motion picture, color, 28 minutes, loan. This film describes the application and performance characteristics of acrylic latex paints for exterior and interior wood, masonry, floors and other surfaces. Both do-it-yourselfers and professional painters are shown applying paints. Rohm and Haas Company.

The Master's Touch–Professional Painters. 16mm motion picture, color, 32 minutes, loan. The first half of this film is identical with *The Master's Touch–Homeowners* (listed above). The second half (1970) uses only professional painters. They are shown preparing surfaces, and applying acrylic latex paints and acrylic latex caulking compounds to many different surfaces including interior dry wall and trim, exterior masonry and wood. Rohm and Haas Company.

Public Works and Public Utilities: Painting Structures Ashore. 16mm motion picture, color, 20 minutes, $68.25. United States National Audiovisual Center.

Ransburg Electrostatic Painting. 16mm motion picture, color, 22 minutes, loan. This film covers the entire Ransburg line of electro-coating processes and equipment available to industry for both production line and maintenance painting. Ransburg Electro-Coating Corporation.

Stand Up and Paint–Exterior. 16mm motion picture, color, 8 minutes, $110. Discusses the basic steps of house painting. Aims Instructional Media Services, Incorporated.

Stand Up and Paint–Interior. 16mm motion picture, color, 11 minutes, $120. Discusses the "stand up" method of quick and simple house painting. Aims Instructional Media Services, Incorporated.

Filmstrip

Repainting Farm Buildings (Part I). Sound filmstrip (77 frames), color, LP record, (1969), $6. NASCO West.

2.27 Roofer

Rain Carrying Equipment. 16mm motion picture, color, 21 minutes, loan. Demonstrates ease of assembly and installation of aluminum gutters and downspouts. Follows cost-saving shop work, accessory refinements and installation techniques. Recommended for roofers, builders, sheet-metal associations and homeowners. (Sponsor request only) ALCOA.

Roofer's Pitch. 16mm motion picture, color, 22 minutes, $195 or loan. Associated Films.

This–Above All. 16mm motion picture, color, 13½ minutes, loan. This film tells the story of roofs as designed during various architectural periods with particular emphasis on contemporary design. It shows the various materials used in roof deck or open-beam ceiling construction, and particularly the use of insulating roof deck contemporary design. Insulation Board Institute.

Filmstrips

Galvanized Roofing and Siding for Farm Buildings. Sound filmstrip, color, 18 minutes, loan. American Iron and Steel.

Selection and Application of Galvanized Roofing and Siding. Filmstrip, black & white, $1.25. Vocational Agriculture Service.

Transparency

Roof Covering. Transparency, $4.50, GAF Reprographic.

Publications

Galvanized Roofing for Farm Buildings. (1968), 14 pages, free. American Zinc Institute.

Lead Roofing and Flashing. (1969), 16 pages, free. Lead Industries.

Literature Packet. Free. Red cedar shingles and shakes; shows how shakes and shingles are made; how to apply; and shows examples of interior and exterior application. Red Cedar Shingle and Handsplit Shake Bureau.

Roof and Wall Shingling Made Easy. 14 pages, free. An excellent booklet on applying wood shingles. Red Cedar Shingle and Handsplit Shake Bureau.

Selection and Application of Galvanized Roofing and Siding. (1968), 20 pages, free. American Zinc Institute.

2.3 LAYOUT TOOLS

2.31 Measurement–Tape, Rule

Basic Layout Tools–Part II. 16mm motion picture, black & white, 7 minutes, $12.50. Stresses care and use of metalworking layout tools. United States National Audiovisual Center.

The Bevel Protractor. 16mm motion picture, black & white, 15 minutes, $27. Shows principles of the varnier bevel protractor; how to set, read and to use. United States National Audiovisual Center.

Carpentry–Part I–Measuring, Marking, and Leveling Tools. 16mm motion picture, black & white, 18 minutes, (1965), (loan from Serina Press), $35.25. Teaches the use, capabilities, and care and maintenance of the carpentry hand tools commonly used for measuring, marking, and leveling. United States National Audiovisual Center.

How to Use Measuring Tools. 16mm motion picture, color, (1970), $150. Visual Instruction.

Measuring and Layout Tools. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

The Steel Rule. 16mm motion picture, black & white, 14 minutes, $25.50. How to read and use steel rules and squares. United States National Audiovisual Center.

Tools and Rules for Precision Measuring. 16mm motion picture, color, 39 minutes, (1969), loan. Worcester Film Corporation.

Filmstrips

Measuring and Layout Tools. Sound filmstrip, color, LP record, 17 minutes, (1969), $10.50. Society for Visual Education.

Measuring and Marketing Timber. Sound filmstrip, (46 frames), color, LP record, (1969), $6. NASCO West.

Using the Level in Farm Surveying. Sound filmstrip (53 frames), black & white, LP record (1969), $1.33. NASCO West.

8mm Motion Pictures

Precision Measuring: Depth Gauge and Inside Micrometer. Super 8mm reel, color, 15 minutes, (1969), $129. Bailey Film Associates.

Precision Measuring: Steel Scale (Part I: The Fractional Scale). Super 8mm reel, color, 8 minutes, (1969), $89. Bailey Film Associates.

Precision Measuring: Steel Scale (Part II: The Decimal Scale). Super 8mm reel, color, 8 minutes, (1969), $89. Bailey Film Associates.

Precision Measuring: Vernier Calipers. Super 8mm reel, color, 15 minutes, (1969), $129. Bailey Film Associates.

Transparency

Lumber Grades and Measurement. Transparency, $3.12, DCA Educational Products.

8mm Loops

How to Make a Measurement. Super 8mm loop, color, (1969), $22.75. McIntyre.

Measuring Tools: Folding Wood Rule. Super 8mm loop, color, (1970), $20. Visual Instruction.

Measuring Tools: Pull-Push and Long Steel Tape. Super 8mm loop, color, (1970), $20. Visual Instruction.

Measuring Tools: Reading a Rule. Super 8mm loop, color, (1970), $20. Visual Instruction.

Measuring Tools: Special Types. Super 8mm loop, color, (1970), $20. Visual Instruction.

Measuring Tools: Their Use. Super 8mm loop, color, (1970), $20. Visual Instruction.

Sizes of Lumber. Super 8mm loop, color, (1969), $22.75. McIntyre.

2.32 Levels–Hand, Builders, Transit

Filmstrips

Laying Out Foundation of a Building. Sound filmstrip (79 frames), color, LP record, $6. NASCO West.

Use of the Level: Reading the Rod. Sound filmstrip (39 frames), color, LP record, (1970), $6.50. Vocational Education.

Use of the Level: Setting Up the Instrument. Filmstrip, (43 frames), color, (1970), $4.50. Vocational Education.

Using the Level to Stake Out a Building Site. Sound filmstrip, (25 frames), black & white, (1969), $1. NASCO West.

8mm Loop

The Spirit Level. Super 8mm loop, color, (1969), $22.75. McIntyre.

2.33 Lines–Chalk Line, Straight Edge

8mm Loops

The Sliding T-Bevel. Super 8mm loop, color, (1969), $22.75. McIntyre.

Straight Edge and the Carpenter's Square. Super 8mm loop, color, (1969), $22.75. McIntyre.

2.34 Squares

Transparency

The Square. Transparency, $3.65, GAF Reprographic.

8mm loops

Combination Square. Super 8mm loop, color, (1969), $22.75. McIntyre.

Measuring and Layout Tools: Squares. Super 8mm loop, color, (1967), $20. Sterling Educational Films.

Precision Measuring: Combination Square. Super 8mm reel, color, 15 minutes, (1969), $129. Bailey Film Associates.

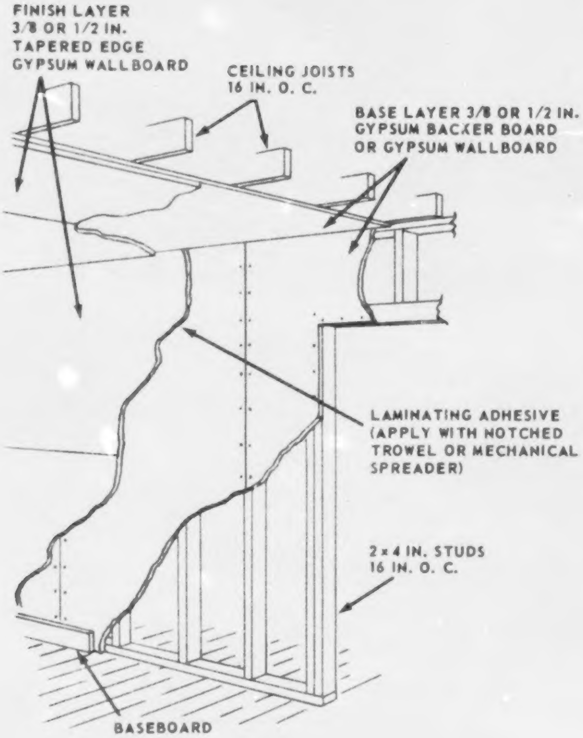
Straight Edge and the Carpenter's Square. Super 8mm loop, color, (1969), $22.75. McIntyre.

2.36 Marking Tools

8mm Loops

Gauging. Super 8mm loop, color, (1969), $22.75. McIntyre.

Layout Tools For Metal Work Series. Super 8mm loop, color, (1967), $20 each. Sterling Educational Films. 1) Layout fluids; 2) Measuring and marking tools; 3) Scriber, punches, dividers; 4) Transferring design to metal; 5) Try squares, dividers, calipers.


FINISH LAYER
3/8 OR 1/2 IN.
TAPERED EDGE
GYPSUM WALLBOARD
CEILING JOISTS
16 IN. O. C.
BASE LAYER 3/8 OR 1/2 IN.
GYPSUM BACKER BOARD
OR GYPSUM WALLBOARD
LAMINATING ADHESIVE
(APPLY WITH NOTCHED
TROWEL OR MECHANICAL
SPREADER)
2 x 4 IN. STUDS
16 IN. O. C.
BASEBOARD

INSTRUCTIONAL CODE NO. 3

Construction Materials

WOODS
SOFTWOODS
Instructional Code 3.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Methods of grading dimension lumber customarily used in construction in the Pacific Northwest: 1. Douglas fir 2. Western red cedar 3. Western hemlock 4. Western larch 5. White fir	Analyze softwoods and determine principal factors in lumber selection: 1. Availability 2. Relative cost 3. Strength 4. Permanence 5. Workability 6. Shrinkage 7. Finishing 8. Color 9. Principal uses 10. Grades Identify and select proper grade and type for specified job.	Prepare tables and charts showing comparison of lumber factors. Prepare display samples of woods along with pertinent data.

WOODS
HARDWOODS
Instructional Code 3.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Methods of recognizing and selecting hardwood lumber customarily used in building construction: 1. Cherry 2. Gumwood 3. White oak 4. Red oak 5. Birch 6. Maple 7. Mahogany 8. Walnut	Select and identify hardwoods from: 1. Color 2. Weight and density 3. Grain pattern Be able to analyze hardwoods for: 1. Availability 2. Relative cost 3. Workability 4. Finish 5. Permanence Identify and select proper grade and type for specific job.	Prepare tables and charts showing comparison of factors. Prepare display samples of woods along with pertinent data.

WOODS
PLYWOODS
Instructional Code 3.13

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of plywoods used in building construction Limitations and advantages of plywoods used in building construction	Select the type of plywoods best suited for specific jobs: 1. Exterior wall finish 2. Interior wall finish 3. Wall and roof sheathing 4. Subflooring 5. Soffets and ceilings 6. Structural units 7. Cabinets	Prepare tables and charts showing types and uses of plywood. Prepare samples of plywood for permanent display showing construction and types. Visit plywood mills.

WOODS
WOOD PRODUCTS
Instructional Code 3.14

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of processed wood products used in building construction	Select and identify various processed wood products: 1. Hardboards	Prepare tables and charts showing comparison of products.
Limitations and advantages of various wood products	2. Particle boards 3. Fibreboards	Prepare samples of wood products for permanent display showing construction processing and types.
	Select the types of processed woods best suited for: 1. Walls and ceilings 2. Underlayment 3. Exterior ceilings 4. Siding 5. Concrete forms	Visit processing plants.

METALS
FERROUS METALS
Instructional Code 3.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of ferrous metal products used in building construction.	Select and identify the following ferrous metals: 1. Cast iron 2. Wrought iron (mild steel) 3. Cold rolled steel 4. Steel structural shapes (mild to medium carbon steel)	Prepare display samples of various ferrous metal products used in building construction, showing characteristics of each.
Advantages and limitations of use and handling of various metal products.	Select and work the various metals in accordance with pertinent characteristics: 1. Relative cost 2. Strength 3. Durability 4. Weight	

METALS
NONFERROUS METALS
Instructional Code 3.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of nonferrous metals used in building construction.	Select, identify, and associate nonferrous metals used in construction: 1. Aluminum Extruded shapes Doors, windows Electric cable Sheet stock 2. Copper Sheets Architectural and ornamental shapes Electric cable Pipe and tubing 3. Lead Sheets 4. Tin Coatings	Prepare samples and charts showing typical nonferrous metals used in construction.
Advantages and limitations of use of nonferrous metals in various building products.	Select and work with the various metals in accordance with: 1. Relative cost 2. Durability 3. Weight 4. Workability 5. Appearance	

PLASTICS
Instructional Code 3.3

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of plastic products customarily used in building construction	Categorize plastic materials in accordance with their principal characteristics and use factors: 1. Types a. Thermoplastic b. Thermosetting 2. Relative cost 3. Main uses in construction 4. Workability 5. Appearance 6. Durability	Collect and set demonstration models of various plastic products.
Characteristics of various plastics	Recognize, identify, and handle without damage plastic products such as: 1. Glass fiber roofing 2. Flat clear sheets 3. Foamed plastic blocks 4. Insulation 5. Wall coverings 6. Floor coverings 7. Floor toppings 8. Counter tops 9. Pipe 10. Coatings 11. Sealers	Prepare charts showing various products along with vital characteristics.

MISCELLANEOUS
ASPHALTS, TARS
Instructional Code 3.51

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Properties, characteristics, and uses of bituminous materials as used in building construction.	Evaluate the properties that are particularly useful in the construction industry: 1. Water resistance	Visit asphalt batch plants.
Advantages and disadvantages in working with bitumens in building construction.	2. Adherence 3. Viscosity–temperature reaction 4. Heat resistance	Prepare charts and samples of bituminous products used in construction.
	Recognize and identify the common types of bitumens used in building construction: 1. Roofings 2. Adhesives 3. Coatings 4. Sealants 5. Paints 6. Paving	

MISCELLANEOUS
GLUES, CEMENT
Instructional Code 3.52

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of various adhesive products used in building construction.	Apply the types of glues normally used in construction: 1. Animal glues 2. Casein glues 3. Starch glues 4. Cellulose cements 5. Rubber adhesives Describe the properties of the various glues that are factors in their selection and use: 1. Materials' bonding powers 2. Heat, cold, and water resistance 3. Curing time 4. Strength 5. Cost 6. Appearance	Prepare charts and samples of various glues along with their properties and uses. Set up and run controlled tests using various glues and common materials. Work to specific test objectives.

MISCELLANEOUS
FINISHES
Instructional Code 3.53

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of various coatings: 1. Decoration 2. Sanitation 3. Preservation 4. Lighting effects 5. Heating effects 6. Safety 7. Economy 8. Improved working conditions	Recognize and identify the various coatings used in construction: 1. Paints Oil Alkyd Latex Metallic 2. Varnishes Resin Synthetic 3. Enamels 4. Shellac–sealer 5. Lacquers 6. Stains 7. Filler Describe the various properties, characteristics, and uses of the above coatings: 1. Covering power 2. Application 3. Cost 4. Drying conditions 5. Durability 6. Weather resistance 7. Workability 8. Types of finish 9. Materials to be coated 10. Thinner used	Procure samples of various products from different paint manufacturers. Prepare charts of various coatings. Make up sample coatings using recommended application methods. Conduct controlled tests of properties of representative coating materials.

MISCELLANEOUS
CEMENT, AGGREGATES
Instructional Code 3.55

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic concrete technology: 1. Ingredients and their properties 2. Proportion of ingredients 3. Selection of ingredients	Recognize and explain characteristics of: 1. Cements Portland cement Aluminous cement Masonry cement White cement 2. Aggregates Stone Shale Slag Vermiculite Sand Demonstrate proportionate mixes required for normal concrete requirements: 2500 lb. mix 3000 lb. mix Be able to determine the basic functions of materials that make up concrete: Cement Aggregate–coarse, fine Water	Visit concrete batch plant. Prepare tables, charts, and samples of cements and aggregates. Audiovisual aids–Portland Cement Association. Hand mix, cure, and have various concrete mixes tested.

MISCELLANEOUS
GYPSUM AND LIME
Instructional Code 3.56

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of gypsum products used in construction	Recognize and select gypsum products 1. Plasters 2. Joint fillers 3. Wallboards 4. Gypsum tiles	Prepare charts and samples of gypsum products used in construction.
Working characteristics of gypsum and gypsum products		Films
Techniques for installing gypsum products without damage to materials	Demonstrate vital characteristics of gypsum products which apply to construction: 1. Workability 2. Relative cost 3. Appearance 4. Durability 5. Handling limitations 6. Fire resistance	
Use of lime in plaster mixes		

MISCELLANEOUS
CLAY PRODUCTS
Instructional Code 3.57

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of clay products customarily used in building construction: 1. Brick 2. Tile 3. Terra cotta Characteristics that affect selection and use of various products.	Categorize clay products according to: 1. Types 2. Uses 3. Relative cost 4. Appearance 5. Workability 6. Durability Recognize and identify various clay products: 1. Brick (size, shape, texture) 2. Tile (size, shape, construction) 3. Veneer and finish units, including glazed and ceramic products	Collect, catalogue, and display samples of various clay products. Visit brickyards.

COVERINGS
LINOLEUM, TILES
Instructional Code 3.62

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
General properties of composition floorings: 1. Sheet and tile linoleum 2. Tiles Asphalt Vinyl Rubber Cork Advantages, limitations, and application data about the various coverings	Recognize and identify the composition flooring products commonly used in building construction. Explain the characteristics of composition floorings that are pertinent to their selection, installation and use: 1. Relative cost 2. Type of base floor 3. Durability 4. Installation 5. Maintenance requirements 6. Finish 7. Resiliency to traffic 8. Fastening methods and materials 9. Floor preparation requirements	Prepare tables, charts, and samples showing the various products along with pertinent factors.

COVERINGS
GLASS
Instructional Code 3.63

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of sheet glass products used in construction	Identify types of sheet glass and list thicknesses and sizes available in: 1. Single strength 2. Double strength 3. Crystal 4. Plate	Collect and display samples of various types of glass products.
Properties and characteristics of glass products used in building construction	Demonstrate properties of glass that affect its handling, installation and use: 1. Relative cost 2. Strength 3. Weight 4. Distortion 5. Grades	Prepare charts and tables showing factors and characteristics of glass.
	Recognize and explain uses for various glass products: 1. Rolled, roughcast, cathedral glass 2. Wired glass 3. Heat-absorbing plate glass 4. Tempered plate 5. Safety glass 6. Insulating glass 7. Glass block	Practice cutting various types of glass.

COVERINGS
PAPER PRODUCTS
Instructional Code 3.64

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and handling properties of paper products used in construction	Recognize and identify paper products used in construction: 1. Sheathing 2. Roofing 3. Insulation 4. Corrugated building products 5. Concrete forms 6. Vapor and moisture barriers 7. Cushioning materials 8. Wallpaper 9. Envelope coverings for other materials 10. Fireproof materials Evaluate the principal factors and characteristics that affect their use: 1. Treatment 2. Sizes available 3. Grades 4. Weight 5. Durability 6. Handling fragility 7. Relative cost	Visit pulp paper mills. Prepare charts, tables, and samples of various products along with vital statistical information.

3.1 WOODS*

3.11 Solid, Dimension, Softwoods

The Forever Living Forests. 16mm motion picture, color, 25 minutes, loan. Story of the redwood forests, and how proper forest management and sound conservation methods ensure a perpetual timber crop and complete utilization of the tree. How redwood is milled for industrial use and for homes, churches, schools. California Redwood Association.

The Mighty Western Forest. 16mm motion picture, color, 27 minutes, loan. The forest area of the western states is shown. Land use is the key theme. Western Wood Products Association.

Properties and Uses of Redwood. 16mm motion picture, color, 21 minutes, loan. Redwood lumber's manufacture; strength; workability; fire, termite and decay resistance; durability, and other characteristics; architectural use; proper fasteners and finishes. California Redwood Association.

Transparencies

Kinds of Siding. Transparency, $2.75, GAF Reprographic.

Lumber Sizes–Dressed Dimensions. Transparency, $3.25, GAF Reprographic.

Microstructure of Softwood. Transparency, $3.12, DCA Educational Products.

Wood Properties–Appearance, Weathering, Resistance and Defects. Transparency, $3.75, DCA Educational Products.

Wood Properties–Hardness, Weight, and Dimensional Stability. Transparency, $4.23, DCA Educational Products.

8mm Loop

Kinds of Woods. Super 8mm loop, color, (1969), $22.75, McIntyre.

Publications

It's a Tree Country. Booklet. Background of forestry and its history, forests' role in building the nation, woodland management, and why our forests produce more wood than is cut each year. American Forest Institute.

Story of Lumber. Booklet. How trees are harvested, transported to mills and made into lumber, veneer, plywood and other useful products. American Forest Institute.

Story of Pulp and Paper. Booklet. The paper-making process, from trees to finished product, and role of scientific research in developing new wood and pulp products. American Forest Institute.

Chart, 35 inches x 25 inches: *Growth of a Tree.* A tree's growth through seed, seedling, and sapling stages; life processes of mature tree; trees' natural enemies, how man helps trees to grow. American Forest Institute.

Chart, 22 inches x 34 inches: *Products of the Tree Farm.* Shows wood products according to manufacturing process, and how one mill's leftovers become another mill's raw material. American Forest Institute.

Map, 25 inches x 35 inches: *Forests and Trees of the United States.* Map of major American forest regions, identifying commercial trees with areas in which they grow. With teacher's guide. American Forest Institute.

3.12 Solid, Dimension, Hardwoods

Patterns of Time–The Hardwood Story. 16mm motion picture, color, 13½ minutes, loan. A deeply interesting presentation of the romance of our hardwood heritage. The film describes how beautiful hardwood figures are selected and matched together in lovely patterns. It shows how hardwood plywood is made in engineered panels to provide maximum durability and stability to bring the authenticity and deep-glowing beauty of the world's finest cabinet-woods within the budget of the average American family. Modern Talking Picture Service.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

Filmstrips

Hardwood Lumbering. Filmstrip (50 frames), color, (1969), $7. McGraw-Hill.

Hardwood Processing. Filmstrip (50 frames), color, (1969), $7. McGraw-Hill.

Transparency

Microstructure of Hardwood. Transparency, $3.12, DCA Educational Products.

3.13 Plywoods

Design vs. Nature's Violence. 16mm motion picture, black & white, 15 minutes, loan. Dramatic documentation of how plywood structures withstood the 1964 Alaska earthquake. Also includes discussion of how plywood's diaphragm action resists hurricane wind forces. Intended for technical or semi-technical audience: architect, engineer, building official. American Plywood Association.

Miracle in Wood. 16mm motion picture, color, 27 minutes, loan. This film shows that the Egyptians and Chinese were the first to use wood in a form which we know as plywood. The film traces the evolution of plywood into one of today's most versatile materials. American Plywood Association.

Patterns of Time–The Hardwood Story. 16mm motion picture, color, 13½ minutes, free loan or purchase for $63.50. Shows how hardwood figures are selected and matched into patterns and how hardwood plywood is made into engineered panels having maximum durability and stability. Fine Hardwoods Association or Modern Talking Picture Service.

Plywood Pallet Bins for Agriculture. 16mm motion picture, color, 18 minutes, loan. Mechanization in agricultural materials handling is a rapidly growing trend. Plywood pallet bins play an important role in this change. As you'll see in this film, everything from raisins to nuts is handled from harvest through processing in plywood bins. Although intended for potential agricultural users, this film also suggests some industrial materials handling ideas. American Plywood Association.

Tamap Roof Sheathing Study. 16mm motion picture, color, 26 minutes, loan. Documents highlights of "time and motion" study on plywood roof sheathing conducted by National Association of Home Builders Research Foundation. Intended for builder, architect, engineer audiences. American Plywood Association.

Slides

Hardwoods Make Fine Furniture. Mounted slide set (30 frames), color, 24 veneer samples, script, 30 minutes, loan. Modern production of hardwood plywood, furniture manufacturing steps and styles. Questions-answers for audience discussion. Fine Hardwoods Association.

The How and Why of Hardwood Plywood Paneling. Mounted slide set (71 frames), color, script, loaned free or purchase for $25. Features remodeling a room. Hardwood Plywood Manufacturing Association.

Publications

Know Your Hardwoods. 12 pages, 50 cents. This sample book shows how to identify the ten most popular cabinet woods and furnishes 3 inches x 4 inches actual veneer samples of each. Lists for each species the origin, color, figure, availability and identifiable characteristics. Also includes glossary of wood terms. Fine Hardwoods Association.

A World of Fine Hardwoods. Prices: 1-29, 25 cents; 30-99, 18 cents; 100 plus, 15 cents each. Fine Hardwoods Association.

The Woods–Thirty most popular hardwood species from round the world pictured and described.

The Veneers–Story of hardwood veneer from the time of ancient Egypt to the present.

3.14 Wood Products

The Big Noise About the Quiet Home. 16mm motion picture, color, 5 minutes, loan. Acoustical and Insulating Materials Association.

Decorate with Quiet. 16mm motion picture, color, 5 minutes, loan. Acoustical and Insulating Materials Association.

Home Sweet Cedar. 16mm motion picture, color, 27 minutes, loan. Scenic views of the Pacific Northwest. Logging, shingle and shake manufacturing, house construction. Red Cedar Shingle and Handsplit Shake Bureau.

Noise: The New Pollutant. 16mm motion picture, color, 30 minutes, loan. Acoustical and Insulating Materials Association.

Time of Change. 16mm motion picture, color, 13½ minutes, loan. This film illustrates the manufacturing process of this modern wood product (hardboard), and includes the many new uses and applications developed within recent years. Recommended for science and industrial arts classes at junior and senior high school levels. Teachers' handbook, "The Story of Hardboard" is available. American Hardboard Association or Modern Talking Picture Service.

Transparencies

Hardboard. Transparency, (1969), $4.23, DCA Educational Products.

Manufacture of Particle Board. Transparency, $2.38, DCA Educational Products.

Slides

Knock on Wood. 35mm slides, sound record, 15 minutes, loaned free or purchase for $10. Properties and uses of wood particleboard, as a core material, for building and furniture production. National Particleboard Association.

A Picture Story of Architectural Acoustics and Acoustical Meterials. Mounted slide set (111 frames), color, loan. Acoustical and Insulating Materials Association.

The Story of Insulation Board. Sound slide-film (set of 3). Acoustical and Insulating Materials Association.

3.2 METALS

3.21 Ferrous Metals

Building with Stainless. 16mm motion picture, color, 22 minutes, (1969), loan. Inland Steel Company.

Shapers of Stainless Steel. 16mm motion picture, color, 18 minutes, (1969), loan. Republic Steel Corporation.

3.22 Nonferrous Metals

Aluminum. 16mm motion picture, color, 28 minutes, loan. The journey of aluminum from deeply buried ore to finished product told in an exciting and motivating production. Recommended for upper elementary, intermediate, junior and senior high, junior colleges, adult groups. Teachers' guide available with film. Modern Talking Picture Service.

Aluminum–Metal of Many Faces. 16mm motion picture, color, 17 minutes, loan. Traces the development of aluminum. Takes you through mining, refining and smelting and illustrates the various forming, joining and finishing processes. Concludes with uses of aluminum. Recommended for 9th grade and above, colleges and adults. ALCOA.

Aluminum On the March. 16mm motion picture, color, 24 minutes, loan. This film shows all of the steps in the production of aluminum, from the mining of bauxite to the finished product. Reynolds Metals Company.

Aluminum On the Skyline. 16mm motion picture, color, 28 minutes, (1969), loan. ALCOA.

Change For the Better. 16mm motion picture, color, 20 minutes, loan. Douglas Fairbanks, Jr. narrates on the changes that have marked man's progress through the ages. The technological advances of the 20th century are emphasized and the role of aluminum is interestingly portrayed. ALCOA or Association Films S-862.

Chemistry of Aluminum. 16mm motion picture, color, 16 minutes, loan. This film shows the production of aluminum from raw bauxite to the finished product. Mill operations show the conversion of aluminum ingots into sheet plate, wire, rod, bar, rolled and extruded shapes and many fabricated products. Reynolds Metals Company.

Copper–The Oldest Modern Metal. 16mm motion picture, color, 28 minutes, loan. Serina Press.

Do-It-Yourself Aluminum. 16mm motion picture, color, 14 minutes, loan. This film demonstrates and explains how the aluminum product which comes in a variety of shapes can be used for building many workshop products, with emphasis on the actual techniques of working with it, including the cutting, bending and drilling of the material. The fact that this aluminum can be used with ordinary woodworking tools is demonstrated. Reynolds Metals Company.

Metal Lath and Accessories–Concrete Reinforced Products. 16mm motion picture, color, 28 minutes, (1969), loan. Republic Steel Corporation.

A Product of the Imagination. 16mm motion picture, color, 26 minutes, loan. A fanciful journey into the aluminum past. Imaginary Adam and Eve tell how aluminum locked in ore state is uncovered by man. Sequences show how aluminum is mined, forged, rolled, drawn, extruded and impacted. Shows future aluminum designs. Recommended for senior high school groups, adult organizations. ALCOA or Associated Films S-598.

Filmstrip

Specifying What You Need and Getting What You Specify. Sound filmstrip, color, LP record, 18 minutes, loan. Looks at AAMA sponsored USA Standards for aluminum windows and sliding glass doors. Technical considerations include factors for wind velocity, design pressure, uniform load structural test pressure and general high performance features. Architectural Aluminum Manufacturers Association.

3.3 PLASTICS

3.31 Hi-Pressure Laminates

The Wood That Could. 16mm motion picture, color, 28½ minutes, loan. Depicts fabrication, quality control and uses of structural glued laminated timber. American Institute of Timber Construction.

Slides

AITC Quality Control and Inspection Program. Mounted slide set (120 frames), color, 30-minute script, loaned free or purchase for $30 plus postage. Depicts quality control and production of structural glued laminated timber in a laminating plant. American Institute of Timber Construction.

Versatile Timber Construction. Mounted slide set (100 frames), color, 25-minute script, loaned free or purchase for $25 plus postage. Variety of laminated timber construction systems and applications are shown. American Institute of Timber Construction.

3.33 Fiberglass Products

Fiber Glass Is . . . 16mm motion picture, color, 12 minutes (also 18 minute version), loan. Tells the story of the versatility and ubiquitousness of fiberglass through an exciting array of end products. Film takes the viewer across country in its demonstration of the many different uses of fiber-glass. PPG Industries, Inc.

3.34 Coatings

The Captain's Idea. 16mm motion picture, color, 30 minutes, loan. Shows way to stop rust and provide protection for many types of metal surfaces subjected to conditions of weather, atmosphere, abrasion, fumes, etc. Rust-Oleum Corporation.

The Silent Enemy. 16mm motion picture, color, 20 minutes, loan. This film is on the subject of protective coatings and maintenance of rustable metal surfaces. Rust-Oleum Corporation.

3.5 MISCELLANEOUS

3.51 Asphalts, Tars

The Perfect Combination. 16mm motion picture, color, 15 minutes, loan. This film shows how asphalt shingles are manufactured and includes a tour of homes roofed with asphalt shingles. Asphalt Roofing Manufacturers Association.

Transparency

Asphalt Shingles. Transparency, (1968), $4, GAF Reprographic.

3.52 Glues, Cements

Glues and Clamps. 16mm motion picture, color, 12 minutes, (1967), $150. Sterling Educational Films.

8mm Loops

Glues and Clamps: Gluing. Super 8mm loop, color, (1967), $20. Sterling Educational Films.

Glues and Clamps: Natural Glue. Super 8mm loop, color, (1967), $20. Sterling Educational Films.

Glues and Clamps: Resin Glues and Contact Cement. Super 8mm loop, color, (1967), $20. Sterling Educational Films.

3.53 Finishes–Paints, Varnishes

Accent On Color. 16mm motion picture, color, loan. Step-by-step picture story of paint being made. Armstrong Paint and Varnish Works.

Captain's Idea. 16mm motion picture, color, 30 minutes, loan. This film presents a broad view of Rust-Oleum rust preventive products and the field of rust prevention in various phases of industry–marine, railroad, construction, farm and house use. It tells the story of how Rust-Oleum originated and its importance in all fields in industry where rustable metal surfaces are to be preserved and protected. Rust-Oleum Corporation.

Miracle in Color (Latex paint). 16mm motion picture, color, 22 minutes, loan. Dow Chemical Company.

Paint. 16mm motion picture, color, 25 minutes, loan. This film traces the history of paint, and the materials from which it has been made, from the cave paintings of the Stone Age to today's sophisticated coatings. Paint Industry Education Bureau.

Paint Science and Technology. 16mm motion picture, color, 26 minutes, loan. A college graduate tours a paint plant and observes the scientific equipment and methods employed. He is shown the skills of formulating, testing and producing today's specialized paints for uses ranging from submarines to skyscrapers to space vehicles. Federation of Societies for Paint Technology.

Seeing Color. 16mm motion picture, color, 18 minutes, loan. Explores the nature of the human eye and its relationship to instruments, showing what can be accomplished with color measuring devices. Dramatizes the story of color. Interchemical Corporation.

This Is Color. 16mm motion picture, color, 27 minutes, loan. Shows relation of light to color. Animation and practical demonstration of the part color plays in design, production and sales. Film is of technical nature. Interchemical Corporation.

8mm Loops

Polymer Paints: Characteristics. Super 8mm loop, color, (1969), $22.75. McIntyre.

Using Polymer Paints. Super 8mm loop, color, (1969), $22.75. McIntyre.

3.54 Specialties–Binders, Dryers, Etc.

Big Noise About the Quiet Home. 16mm motion picture, color, 15 minutes, loan. This film describes the techniques that can be used to achieve a meaningful atmosphere of quiet in a new home or garden apartment. It shows what should be done with ceilings, walls, appliances, heating, cooling, plumbing and other elements of a home to achieve restful heathful quiet. Insulation Board Institute.

It's All In the Wall. 16mm motion picture, color, 15 minutes, loan. This film tells the story of the vermiculite masonry fill insulation. It presents case histories of various types of buildings across the United States and Canada and includes the newest techniques for insulating block and cavity walls quickly and economically. Sound-deadening of partitions is also covered. Vermiculite Institute, Zonolite Division.

Lightweight Champion. 16mm motion picture, color, 18 minutes, loan. This film portrays the weight-saving inherent in the use of vermiculite plaster and vermiculite acoustical plastic in dwelling and multistory construction. It also indicates some of its fire resistive qualities. Zonolite Division.

Shaping the Future with Gypsum Roof Decks. 16mm motion picture, color, 26 minutes, loan. Shows fire resistance; strength and low cost qualities of gypsum roof deck construction. Gypsum Association.

Shaping the Future with Gypsum Wallboard. 16mm motion picture, color, 23½ minutes, loan. The application of gypsum wallboard in construction of modern buildings. Gypsum Association.

Wood Plastic: A New Dimension. 16mm motion picture, color, 11 minutes, (1969), $145. International Film Bureau.

Filmstrip

New Insulation for Masonry Walls. Sound filmstrip, color, LP record, 10 minutes, loan. Methods of insulating concrete or brick cavity walls with vermiculite. Zonolite Division.

Slide

Dur-O-Wal Masonry Wall Reinforcement. Mounted slide set (172 frames), loan. Presents many application illustrations plus technical data. Dur-O-Wal National, Incorporated.

3.55 Cement, Plaster, Lime

From Mountains to Microns. 16mm motion picture, color, 24½ minutes, (1959), loan. Shows production of portland cement from raw materials to finished product. Includes outstanding examples of concrete, use of cement in making concrete, and brief examination of organization and work of the Portland Cement Association. Modern Talking Picture Service.

Hidden Strength. 16mm motion picture, color, 20 minutes, loan. This film deals with cement and concrete. It describes and illustrates the many ways in which portland cement and keymesh reinforcing have been used. The Venard Organization.

It's The Top. 16mm motion picture, color, 18 minutes, loan. This film deals with vermiculite concrete roof decks and describes the mixing, placing, and physical properties of vermiculite concrete. It shows new pumping and spraying techniques on a variety of roof systems and on decks with hyperbolic paraboloid barrel and other irregular shapes. Vermiculite Institute.

Penny A Pound (cement manufacturing). 16mm motion picture, color, 20 minutes, (1964), loan. Calaveras Cement Company.

Principles of Quality Concrete. 16mm motion picture, color, 23 minutes, (1969), loan. A new version of the film which explains the fundamental principles of quality concrete and procedures for design of mixtures. It describes the properties of the cement-water paste and how they are determined by the water-cement ratio; illustrates the process of hydration; and explains the effects of the characteristics of the aggregate on the quality of plastic and hardened concrete. The importance of air entrainment is stressed. Modern Talking Picture Service.

Shape of the Future. 16mm motion picture, color, 14 minutes, loan. This film is an information film of general interest to all audiences. It shows the mining and processing of gypsum from raw rock to its many uses in the world today. Gypsum Association.

Shaping the Future With Gypsum Roof Decks. 16mm motion picture, color, 26 minutes, loan. This film shows the mining processing of gypsum from raw rock to its final form (same as the film, *Shape of the Future*), plus a comprehensive coverage of the fire resistance, strength and low cost qualities of gypsum roof deck construction. Gypsum Association.

Shaping the Future With Gypsum Wallboard. 16mm motion picture, color, 23½ minutes, loan. This film includes the film, *Shape of the Future*, which covers the mining and processing of gypsum from the raw form of rock to its final form, plus the application of gypsum wallboard for good fire resistance construction in modern buildings. Gypsum Association.

Shaping the Future With Lath and Plaster. 16mm motion picture, color, 24 minutes, loan. Includes the film, *Shape of the Future*, and a demonstration of the proper application of gypsum lath and plaster for strong, fire resistant walls and ceilings. Gypsum Association.

Stucco and Plaster–New Dimensions in Oldest Building Art. 16mm motion picture, color, 22 minutes, (1966), loan. Briefly reviews stucco and plaster usage from ancient times to the present and gives examples of fascinating new uses and applications on all types of structures. Examples include marblecrete, simulated brick, graffito, stone, and coral facings. Modern Talking Picture Service.

Filmstrip

How We Get Our Cement. Filmstrip (40 frames), black & white, $4. Key Productions.

Publication

Using Gypsum Board for Walls and Ceilings. Booklet, 40 pages, (1970), 50 cents. Gypsum Association.

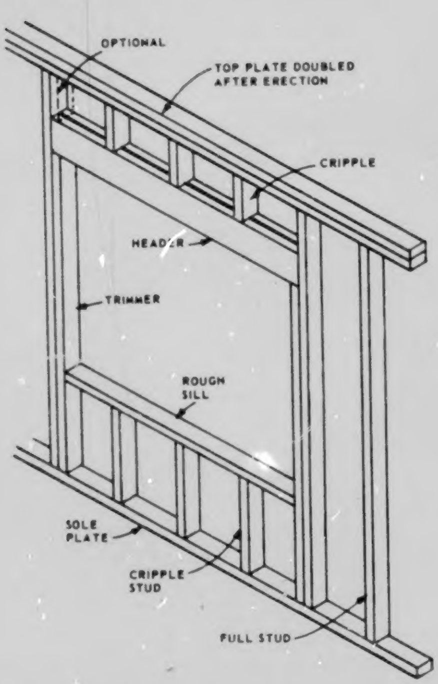
3.57 Clay Products

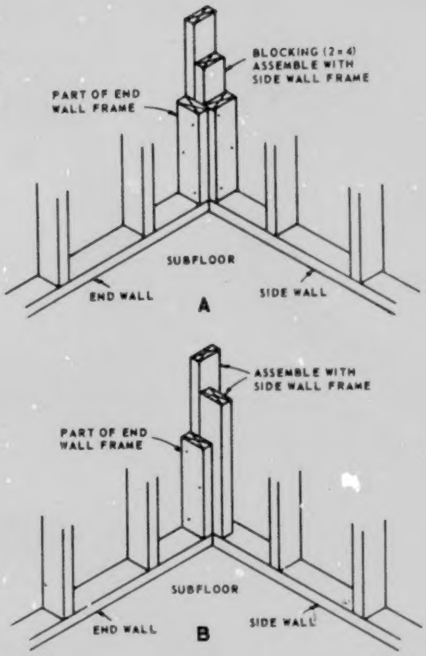
Clay and Shale (Clay Industry). 16mm motion picture, black & white, 15 minutes, (1970), loan. Serina Press.

3.6 COVERINGS

3.64 Paper Products

Painting and Decorating: Paperhanging Application. 16mm motion picture, color, 12 minutes, $150. Sterling Educational Films.


OPTIONAL
TOP PLATE DOUBLED AFTER ERECTION
CRIPPLE
HEADER
TRIMMER
ROUGH SILL
SOLE PLATE
CRIPPLE STUD
FULL STUD


BLOCKING (2×4) ASSEMBLE WITH SIDE WALL FRAME
PART OF END WALL FRAME
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SUBFLOOR
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INSTRUCTIONAL CODE NO. 4

Cutting and Fitting

CUTTING CHARACTERISTICS OF MATERIALS
WOODS
Instructional Code 4.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of wood that determine economic and quality cutting techniques	Recognize the characteristics of wood that govern the selection of cutting tools and methods of cutting: 1. Fibre and ring structure 2. Class of trees Hardwoods Softwoods 3. Wood layers Heartwood Sapwood Springwood Summerwood 4. Moisture and seasoning 5. Lumber gain 6. Defects Knots–sizes, soundness Checks Pitchpockets	Display tree growth charts. Prepare charts showing factors that influence cutting of woods.

CUTTING CHARACTERISTICS OF MATERIALS
METALS
Instructional Code 4.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Properties of metals that govern cutting methods and tools.	Evaluate the properties of metal products common to construction that govern the selection of cutting tools: 1. Density 2. Brittleness 3. Melting point 4. Malleability 5. Identification codes 6. Ferrous–nonferrous 7. Relative hardness 8. Weight	Prepare tables and charts showing pertinent properties of various construction metals–ferrous and nonferrous.

CUTTING CHARACTERISTICS OF MATERIALS
PLASTICS
Instructional Code 4.13

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of various plastics which influence proper cutting and fitting.	Determine the characters present in various plastics which determine ease or difficulty of cutting process. Recognize properties that present special procedures. 1. Hardness 2. Brittleness 3. Strength 4. Effects of heat 5. Resistance to pressure or friction 6. Tearing and chipping qualities 7. Fiberous quality 8. Effects of cold	Select various types of plastic and examine for different properties that might affect cutting.

CUTTING CHARACTERISTICS OF MATERIALS
MISCELLANEOUS MATERIALS
Instructional Code 4.14

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of and cutting tools used for miscellaneous construction products, such as: 1. Glass 2. Tiles 3. Coverings 4. Paper 5. Clay 6. Fabrics	Determine the composition of products common to construction that have a bearing on their cutting: 1. Size 2. Density 3. Hardness 4. Brittleness 5. Splinter and chip tendencies 6. Reaction to heat 7. Reaction to pressure	Set up exercises requiring indentification and evaluation of miscellaneous materials and selection of cutting tools.

SELECTION OF CUTTING TOOLS
WOODS
Instructional Code 4.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Appropriate use of wood-cutting tools in terms of: 1. Time available 2. Tools available 3. Job requirements Cutting characteristics of various wood cutting tools: 1. Saws 2. Knives 3. Drills 4. Files	Select the most appropriate cutting tools for woods, considering: 1. Type of wood 2. Grain direction to be cut 3. Finish desired 4. Accuracy required 5. Moisture content 6. Labor-saving factors 7. Size of cut to be made 8. Type of cut Straight Curved Partial 9. Space and room conditions	Set up exercises requiring selection and operation of cutting tools. Critique selection.

SELECTION OF CUTTING TOOLS
METALS
Instructional Code 4.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Appropriate use of metal-cutting tools in terms of: 1. Time available 2. Tools available 3. Job requirements Cutting characteristics of: 1. Saws 2. Shears 3. Knives 4. Drills 5. Files 6. Oxyacetelene	Select most appropriate metal-cutting tools based upon: 1. Metal hardness 2. Metal density 3. Metal size 4. Space available 5. Accuracy requirements 6. Type and shape of cut	Set up exercises requiring selection and operation of cutting tools. Critique operation. Conduct demonstrations showing problems in selection of wrong cutting tools—emphasize time and damage factors.

SELECTION OF CUTTING TOOLS
PLASTICS
Instructional Code 4.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of cutting tools for plastic products Techniques for handling and cutting plastic products	Select most appropriate cutting tools, considering: 1. Accuracy required 2. Tools available 3. Labor-saving factors 4. Possible damage to tool 5. Fitting and joint requirements	Set up exercises requiring selection and operation of cutting tools. Critique operation. Conduct demonstrations showing problems in selection of wrong cutting tools. Emphasize damage and breakage factors.

SELECTION OF CUTTING TOOLS
MISCELLANEOUS MATERIALS
Instructional Code 4.24

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Appropriateness of the following tools for cutting miscellaneous materials: 1. Knives 2. Saws 3. Scoring tools 4. Planes 5. Abrasives 6. Snips 7. Files 8. Drills 9. Burning torch	Select proper cutting tool for miscellaneous materials using the following factors as a basis for selection: 1. Type of material 2. Size of stock 3. Type of cut 4. Finish desired 5. Accuracy required 6. Labor-saving factors 7. Safety 8. Space available 9. Minimum wear on tool 10. Minimum loss of material	Use visual aids. Gather as many types of miscellaneous materials and make sample cuts using various tools and methods. Observe effect on materials, tools, time, and effort required.

MEASURING AND MARKING
Instructional Code 4.3

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Techniques for transcribing measurements from plans or diagrams to construction materials in preparation for cutting.	Select and use the most appropriate marking devices for cutting, considering: 1. Type of cutting tool to be used 2. Material being marked 3. Accuracy requirements 4. Type of cut to be made 5. Visibility Measure and mark for cutting materials of various shapes: 1. Linear 2. Round 3. Cylindrical 4. Rectangular 5. Random shaped	Extend charts of "Construction Materials" (Instruction Code No. 3) to include "Marking devices used." Conduct marking exercises using various materials such as: 1. Glass 2. Pipe 3. Rough lumber 4. Brick 5. Tile 6. Asphalt paper

MAINTENANCE OF CUTTING TOOLS
Instructional Code 4.4

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Proper care of cutting tools to: 1. Insure true and accurate cuts 2. Minimize undue wear 3. Minimize operator fatigue 4. Eliminate excessive sharpening and repair costs	Demonstrate proper care of cutting tools: 1. When storing 2. While making cuts 3. By using correctly 4. By lubricating properly	Organize and conduct a continuous maintenance program for all tools and machines. Stress should be placed upon forming good working habits as well as getting maximum usage from the tools and machines.
Techniques for sharpening cutting tools	Judge when cutting surfaces need sharpening or replacing.	
	Grind, hone, or file: 1. Chisels and plane blades 2. Simple shears 3. Drills	

CUTTING TOOLS–SAWS
HANDSAWS, HACKSAWS
Instructional Code 4.51

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Appropriate uses of various saws	Recognize, identify, and demonstrate principal uses of the types of saws common to construction: 1. Wood cutting saws Ripsaw Crosscut saw Backsaw Coping saw Compass saw 2. Metal cutting saws Hand hacksaw Power hacksaw 3. Demonstrate the characteristics of various saws in use: Set Size and no. of teeth Angle of teeth Angle of cutting edge Operate a selected saw so as to make a clean, square cut without damage to the saw or to the material. Demonstrate practices necessary to maintain sharp saws.	Prepare tables of saws and their uses. Practice identification and selection before checking out saws to students.

CUTTING TOOLS–SAWS
CIRCULAR SAWS
Instructional Code 4.52

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types, characteristics and uses of circular saws Safety rules Proper maintenance procedures	Identify types of circular saws and their characteristics: 1. Types Table saw Radial saw Portable 2. Characteristics Principal uses Sizes Power factors Adjustments Safety practices required Built-in safety features Select and identify circular saw blades: 1. Rip 2. Crosscut 3. Combination 4. Planer 5. Hollow ground Use correct safety procedures for: 1. Table saw–rip, crosscut, dado 2. Radial saw–crosscut, miter, dado 3. Portable saw–rip, crosscut	Use audiovisual aids.

CUTTING TOOLS–SAWS
BAND, JIG, RECIPROCATING
Instructional Code 4.53

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and characteristics of power-feed straight-blade saws	Identify and operate:	Use visual aids.
	1. Band saws (wood and metal)	
Safety rules	2. Jig saws	Check out student performance on all machines, using specific cutting and safety exercises.
	3. Reciprocating saws (saber)	
Proper maintenance procedures	Describe characteristics of each machine:	
	1. Advantages and limitations	
	2. Sizes	
	3. Capacities	
	4. Adjustments	
	5. Built-in safety features	
	6. Safety practices required	
	Judge the need for and change blades in all machines.	

CUTTING TOOLS–KNIVES
CHISELS
Instructional Code 4.61

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of cutting chisels	Identify the types of hand chisels used in construction: 1. Wood chisels 2. Ripping chisels 3. Cold chisels 4. Glaziers chisels 5. Brick chisels 6. Steel-wood rough chisels	Prepare tables showing types of chisels and pertinent characteristics: 1. Bevel 2. Size 3. Designed uses
Proper maintenance procedures	Describe the characteristics of various chisels: 1. Angle of bevel 2. Size of blades 3. Metal quality 4. Type of handle 5. Sharpening materials	Conduct supervised sharpening exercises.
Safety precautions	Grind and hone chisels properly.	Demonstrate correct use of specific chisels for specific purposes.
	Select and use the appropriate chisels for: 1. Finish wood cuts 2. Rough wood cuts 3. Shearing metal	

CUTTING TOOLS–KNIVES
KNIVES, SCORING TOOLS
Instructional Code 4.62

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of knife edged and scoring tools: 1. Utility knife 2. Hand axe 3. Linoleum knife 4. Wallpaper knife Proper maintenance procedures	Identify and describe the characteristics of various knife-edged tools: 1. Type of bevel edge–single, double 2. Size of tool 3. Shape of tool and handle 4. Sharpening materials 5. Safety factors 6. Principal uses 7. Advantages, limitations Grind and hone bevel edge tools properly. Use various knives: 1. Appropriately 2. Safely 3. Without damage to tool or material 4. Without undue loss of time	Demonstrate correct use of specific tools for specific jobs. Conduct supervised student checkouts.

CUTTING TOOLS–KNIVES
PLANES, PLANERS
Instructional Code 4.63

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of planes 1. Wood planes Block Smoothing Jack 2. Planers Jointers Portable electric Routers Proper maintenance procedures	Identify and describe the characteristics of various planing tools: 1. Principal use 2. Size of cutting head 3. Overall size/capacity 4. Built-in safety features 5. Desirable safety practices 6. Advantages, limitations Use hand planes properly and make the appropriate adjustments for most effective cutting. Use power tools for their intended purpose: 1. Appropriately 2. Safely 3. Without damage to tool or material Grind and hone cutting edges and make sharpening adjustments.	Demonstrate correct procedures for specific tools. Conduct supervised student checkouts. Use visual aids.

CUTTING TOOLS–SHEARS SNIPS, SCISSORS

Instructional Code 4.71

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of shearing tools: 1. Metal tin snips 2. Bolt cutters 3. Hand nippers 4. Scissors	Select and use the appropriate tool for cutting construction materials: 1. Without damage to tool or material 2. Safely Describe the pertinent characteristics of shearing tools: 1. Principal uses 2. Capacity in hardness and thickness 3. Advantages 4. Limitations Use and store tools to minimize damage and dulling.	Conduct cutting demonstrations which include both the selection and use of shearing tools. Conduct exercises involving the selection of correct cutting tools for sample materials.

CUTTING TOOLS--SHEARS
PIPE AND TUBING CUTTERS
Instructional Code 4.72

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of: 1. Tubing cutters and reamers	Cut and ream small copper, brass, aluminum tubing, and thin wall pipe.	From pipe stock cut and ream stock size nipples for maintenance stock.
2. Pipe cutters and reamers 3. Circular paper cutters	Accurately and cleanly cut steel pipe from 3/8 inch to 2 inches diameter.	Conduct exercises stressing fast, accurate and smooth cuts.
Proper maintenance procedures	Demonstrate how to keep cutting edges sharp, clean, and well oiled while in use and in storage.	

ABRADING CUTTING TOOLS
FILES, RASPS
Instructional Code 4.81

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of files and rasps: 1. Single cut–smooth 2. Double cut–rough 3. Rasp cut–wood 4. Curve tooth–metal 5. Square 6. Triangle 7. Half round 8. Round 9. Flat 10. Knife	Select and use the most appropriate type of abrading tool for specific jobs: 1. Providing required smoothness 2. Providing fastest cutting 3. Without damage to file or stock 4. Sized and shaped to fit the job Demonstrate how to use and store files to maintain clean and sharp cutting teeth.	Prepare charts and displays of various types of files and their principal uses.

ABRADING CUTTING TOOLS
PAPERS, STONES, BELTS, WHEELS
Instructional Code 4.82

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of abrading and grinding materials:	Recognize, identify, and select abrading papers according to:	Prepare charts and samples of various abrading and grinding materials used in construction.
1. Emery cloth and paper	1. Grit number	
2. Garnet papers and cloth	2. Type of grit	Use visual materials.
3. Oil stone	3. Size and type of backing	
4. Grinding wheel	4. Designated purpose	
Safe operating techniques for power machines using abrading and grinding materials:	Describe the characteristics of sanding and grinding machines:	
1. Sanders–belt, wheel, disc	1. Principal uses	
2. Grinders–sharpening, portable facing	2. Sizes–capacities	
	3. Advantages	
	4. Limitations	
	5. Safety features	
	6. Minimal damage to machine and stock	

MISCELLANEOUS CUTTING TOOLS
BURNING TORCH
Instructional Code 4.91

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Principles of cutting using oxygen and acetylene cutting equipment.	Properly operate oxyacetylene cutting equipment in making simple jobs cuts; bolts, clips, plates, etc.	Conduct cutting exercises, stressing safety and maintenance.
Types and uses of cutting equipment, tips, and torches.	Demonstrate the protective measures required while operating cutting equipment.	
	Properly maintain, while in and out of use, equipment associated with cutting gauges, hoses, tanks, cutting heads, cutting tips, protective equipment.	

MISCELLANEOUS CUTTING TOOLS
DRILLS
Instructional Code 4.93

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of drills: 1. Twist drills 2. Reamers 3. Auger bits 4. Masonry drills 5. Expansion bit Proper maintenance procedures	Describe characteristics of various boring tools: 1. Principal uses 2. Sizes available 3. Recommended turning speeds Identify and select most appropriate drills for specific boring jobs related to construction. Correctly and safely operate boring machines: 1. Drill press 2. Portable electric drill 3. Portable hand drill 4. Carpenter brace Sharpen and maintain bits and drills properly.	Prepare charts and displays showing various kinds and types of drills along with pertinent characteristics.

4.5 CUTTING TOOLS–SAWS*

4.51 Handsaws, Hacksaws

Care and Use of Hand Tools–Part VI, Hacksaws. 16mm motion picture, black & white, 18 minutes, loan. Serina Press.

Carpentry–Part III–Sawing and Boring Tools. 16mm motion picture, black & white, 33 minutes, loan from Serina Press or purchase from United States National Audiovisual Center for $58.75.

Hacksaws. 16mm motion picture, black & white, 18 minutes, $32. Shows types of hacksaw frames and explains proper and improper use of each type. U.S. National Audiovisual Center.

Hacksaws–Part III. 16mm motion picture, black & white, 5 minutes, $9.25. Explains types of hacksaw blades and shows correct practice. U.S. National Audiovisual Center.

Hacksaws and How to Use Them. 16mm motion picture, color, 30 minutes, loan. This film teaches the best methods of hacksaw cutting, both hand and power. With specific information on proper choice and correct use of hacksaw blades, it shows in slow motion what actually happens when cutting a variety of materials. Simonds Saw and Steel Corporation.

Taking the Hack Out of Hack Sawing. 16mm motion picture, color, 28 minutes (1969), loan. Simonds Saw and Steel Corporation.

8mm Loop

Hacksaw. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

The Hacksaw in Woodworking. Super 8mm loop, color, (1969), $22.75. McIntyre.

Saws: Compass, Keyhole and Coping Saw. Super 8mm loop, color, (1970), $20. Visual Instruction.

The Spoke Shave. Super 8mm loop, color, (1969), $22.75. McIntyre.

Using a Back Saw. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica Educational Corporation.

Publications

Hack Saws and How to Use Them. Booklet, free. Simonds Saw & Steel Corporation.

How to File a Crosscut Saw. Pamphlet, free. Simonds Saw & Steel Corporation.

How to Select and Use Power Hacksaw Blades. Booklet, 15 pages, free. Keller Division of Sales Service Manufacturing Company.

4.52 Circular Saws

Beveling, Mitering, Rabbeting and Dadoing. 16mm motion picture, black & white, 19 minutes, $33.75. How to cut a bevel with a tilted fence; set a miter gauge; use a stopblock in metering; cut rabbets; and use a dado head. U.S. National Audiovisual Center.

Cutting Cove Molding and a Core Box. 16mm motion picture, black & white, 19 minutes, $27. How to select stock, cut and rip cove molding, select blade for oblique cutting. United States National Audiovisual Center.

Cutting Grooves with Circular Saw Blades. 16mm motion picture, black & white, 22 minutes, $38.50. How to set up machine to cut grooves. United States National Audiovisual Center.

How to Use Saws. 16mm motion picture, color, (1970), $150. Visual Instruction.

Ripping and Cross-Cutting. 16mm motion picture, black & white, 19 minutes, $37.75. How each working part of the variety saw operates; how to check saw blades; set fences; and change saw blades. United States National Audiovisual Center.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

Filmstrips

Circular Saw. Sound filmstrip set (6 filmstrips), color, LP record, $20 each. Pacific Productions.

1. *Introduction and Personal Safety.* Shows the basic conponents of circular saws and explains function of each. Also explains the reasons for following safety procedures whenever operating circular saws.

2. *Selecting and Installing Blades.* Examples of the basic types of ripping and crosscutting saws and their functions are shown. The need for various sizes, types and saw tooth configurations is explained. Correct and safe installation procedures are outlined.

3. *Preparing the Saw to Rip.* Explains the need for and use of the fence, splitter and blade guard in ripping. How to test the accuracy of the ripping fence setting is shown.

4. *Ripping, Part I.* Covers the ripping operation with saw blade at 90° . . . shows correct operator position, safe use of hands. The use of the push stick is taught as the method to use when neither hand can pass the front of the blade.

5. *Ripping, Part II.* Pictures the three remaining ripping situations in which passing the blade can be accomplished with (1) left hand only, (2) right hand only and, (3) both hands. Also covers the ripping of large plywood sheets, using a back table and a tail-off man.

6. *Crosscutting.* This presentation shows how to use a miter gauge, check for correct angle, measure accurately, and feed properly.

The Circular Saw. Filmstrip, (16 frames), (1969), $3.50. Educational Media.

Straight Sawing. Filmstrip (59 frames), color, LP record, (1970), $6.50. Basic cuts with the stationary circular saw and the radial arm saw. Society for Visual Education.

8mm Motion Picture

Portable Electric Saws. Super 8mm reel, color, 22 minutes, (1969), $179. Bailey Film Associates.

8mm Loops

Adjusting a Circular Saw. Super 8mm loop, color, 4 minutes, $19.50. CENCO Educational Aids.

Adjusting a Radial Arm Saw. Super 8mm loop, color, 4 minutes, (1969), $19.50 CENCO Educational Aids.

Crosscutting. Super 8mm loop, color, 4 minutes, (1969), $20. Presents the crosscutting blade and the combination blade and demonstrates cuts in plywood. Emphasizes safety. Bailey Films.

Dado and Rabbet Cuts. Super 8mm loop, color, 4 minutes, (1970), $25. Using a radial arm saw to make dado and rabbet cuts. Ealing Film Loops.

Parts of a Circular Saw. Super 8mm loop, color, 4 minutes, (1969), $19.50. CENCO Educational Aids.

Parts of a Radial Arm Saw. Super 8mm loop, color, 4 minutes, (1969), $19.50. CENCO Educational Aids.

Portable Electric Saw. Super 8mm loop, color, 4 minutes, (1970), $25. Techniques in using a portable electric saw. Safety techniques are emphasized. Ealing Film Loops.

Rip and Crosscut Sawing. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica Educational Corporation.

Rip, Bevel and Spline Cuts. Super 8mm loop, color, 4 minutes, $25. Uses "in and out" scales, and shows the use of correct feed direction on radial arm saws. Ealing Film Loops.

Ripping. Super 8mm loop, color, 4 minutes, (1969), $20. Use of the portable circular saw: installing blade, using rip guide and tilting adjustment for bevel cuts. Bailey Film Associates.

Types of Saws and Adjustments. Super 8mm loop, color, 4 minutes, (1969), $20. The plastic-body saw and the metal-body saw; correct adjustments for rip guide and saw tilting. Bailey Film Associates.

Using A Radial Arm Saw. Super 8mm loop, color, 4 minutes, (1969), $17.50. CENCO Educational Aids.

Publication

Chart, 8½ inches x 11 inches: This chart gives lubrication suggestions for most stationary power tools and machine tools. The advantages of dry lubricants such as hard wax are explained. Free. Rockwell Manufacturing Company.

4.53 Band, Jig, Reciprocating

Band Saw. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

Sawing a Reverse Curve and a Bevel Reverse Curve. 16mm motion picture, black & white, 18 minutes, (1969), $32. U.S. National Audiovisual Center.

Sawing with Jig and Changing Band. 16mm motion picture, black & white, 16 minutes, $35.25. How to select proper band saw blades, adjust guides, cut to mark, prepare jig and cut discs using jig. United States National Audiovisual Center.

Filmstrips

The Band Saw. Filmstrip, (16 frames), (1969), $3.50. Educational Media.

Curved Sawing and Drilling. Sound filmstrip (54 frames), color, LP record, (1970), $6.50. Describes band saw, scroll saw and drill press. Demonstrates jigs and setups that can be used with this equipment. Society for Visual Education.

8mm Loops

Saber Saw. Super 8mm loop, color, 4 minutes, (1970), $25. Demonstrates the cutting properties unique to the saber saw. Ealing Film Loops.

Saber Saw: Wood Cutting. Super 8mm loop, color, (1969), $20. Bailey Film Associates.

4.6 CUTTING TOOLS–KNIVES

4.61 Chisels

Care and Use of Handtools–Part III–Chisels. 16mm motion picture, black & white, 12 minutes, loan. Serina Press.

Carpentry–Part IV, Planing and Chiseling Tools. 16mm motion picture, black & white, 11 minutes, loan from Serina Press or purchase for $19.25 from United States National Audiovisual Center.

Chisels. 16mm motion picture, black & white, 12 minutes, $22.25. United States National Audiovisual Center.

How to Use Chisels and Gouges. 16mm motion picture, color, (1970), $150. Visual Instruction.

Metal Cutting Chisels–Part VI. 16mm motion picture, black & white, 5 minutes, $9.25. Shows varieties of metal cutting chisels and explains use. U.S. National AV Center.

Filmstrip

Chisels and Punches. Sound filmstrip, color, (50 frames), (1969), $12.25. Bailey Film Associates.

8mm Loops

Chisels and Gouges: Series. 8mm loop, color, (1970), $20 each. Visual Instruction. 1) Common Types of Chisels, 2) Cutting a Middle Half-Lap, 3) Procedures and Safety, 4) Sharpening a Chisel, 5) Their Parts, 6) Their Purpose, 7) Types of Cuts, 8) Using a Chisel.

Router: Series. Super 8mm loop, color, 3 minutes, (1970), $20 each. Eyegate House. 1) Bits and inserting them, 2) Finished cuts and accessories, 3) Its parts, 4) Procedures and safety, 5) Setting bits and trial cuts.

Sharpening the Chisel: Grinding. Super 8mm loop, color, (1969), $22.75. McIntyre.

Sharpening the Chisel: Whetting. Super 8mm loop, color, (1969), $22.75. McIntyre.

Using a Bevel Edge Chisel. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica Educational Corporation.

Using a Mortise Chisel. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica Educational Corporation.

4.62 Knives, Scoring Tools

The Router. 16mm motion picture, color, 12 minutes, (1970), $150. Visual Instruction.

8mm Loop

Using Linoleum Cutting Tools. Super 8mm loop, color, (1969), $22.75. McIntyre.

4.63 Planes, Planers

Beveling, Stop Chamfering, and Tapering Square Stock. 16mm motion picture, black & white, 20 minutes, $35.25. How to set fence for bevel cutting, cut chamfer. U.S. National AV Center.

Face Planing Uneven Surfaces. 16mm motion picture, black & white, 13 minutes, $23.75. Shows how to determine condition of boards, face wide and thin stock. U.S. National AV Center.

How to Use Planes. 16mm motion picture, color, (1970), $150. Visual Instruction.

Jointing an Edge For Gluing: Installing Knives. 16mm motion picture, black & white, 21 minutes, $37. How to determine when knives are dull; remove dull knives; install sharp knives; and adjust. U.S. National AV Center.

Jointing Edges and Ends 90 Degrees to Face. 16mm motion picture, black & white, 17 minutes, $30.50. Functions and operation of the jointer. Joint a square edge to size and joint a piece of glued stock to size. U.S. National AV Center.

Machine Knives In Industry. 16mm motion picture, color, 40 minutes, loan. This film shows the making of various kinds of machine knives from the pouring, forging, and rolling of the steel to the completed knife as it comes from the production line. These various knives–hog, planer, veneer, chipper, and paper–are shown in actual use in mills and factories. Simonds Saw and Steel Company.

Planes. 16mm motion picture, color, 14 minutes, (1967), $150. Sterling Educational Films.

Planing Rough Surfaces to Dimensions. 16mm motion picture, black & white, 17 minutes, $30.50. How to prepare for planing; plane stock to uniform thickness; adjusting the planer. U.S. National AV Center.

Rabbeting and Shaping An Edge on Straight Stock. 16mm motion picture, black & white, 18 minutes, $32. Principle of shaper operation. U.S. National AV Center.

The Router. 16mm motion picture, color, 12 minutes, (1970), $150. Visual Instruction.

Shaping After Template and Shaping Curved Edges. 16mm motion picture, black & white, 17 minutes, $30.50. How to make a template for the job; install knives in the spindle and shape a curved edge. U.S. National AV Center.

Filmstrip

The Jointer. Filmstrip, (16 frames), (1969), $3.50. Educational Media.

8mm Loops

Adjusting the Jointer. Super 8mm loop, color, 4 minutes, (1969), $19.50. CENCO Educational Aids.

Parts of a Jointer. Super 8mm loop, color, 4 minutes, (1969), $19.50. CENCO Educational Aids.

Planes: Set. Super 8mm loop, color, (1970), $20 each. Visual Instruction. 1) Block Planes, 2) Common Types, 3) Making

Adjustments, 4) Other types, 5) Rabbet and Other Planes, 6) Sharpening the Plane Iron, 7) Their Parts, 8) Their Purpose, 9) Using a Plane.

Planing and Beveling. Super 8mm loop, color, (1970), $20. Visual Instruction.

Router: Bits and Inserting Them. Super 8mm loop, color, (1970), $20. Visual Instruction.

Router: Finished Cuts and Accessories. Super 8mm loop, color, (1970), $20. Visual Instruction.

Router: Its Parts. Super 8mm loop, color, (1970), $20. Visual Instruction.

Router: Procedures and Safety. Super 8mm loop, color, (1970), $20. Visual Instruction.

Router: Setting Bits and Trial Cuts. Super 8mm loop, color, (1970), $20. Visual Instruction.

Sharpening Plane–Irons and Chisels. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica.

Using a Jack Plane. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica.

Using a Jointer Safely. Super 8mm loop, color, 4 minutes, (1969), $17.50. CENCO Educational Aids.

Using the Plough Plane. Super 8mm loop, color, 3 minutes, (1969), $17.60. Encyclopaedia Britannica.

Using the Rabbet Plane. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica.

4.7 CUTTING TOOLS–SHEARS

4.71 Snips, Scissors

Carpentry–Part II–Chopping and Driving Tools. 16mm motion picture, black & white, 14 minutes, loan from Serina Press or purchase from U.S. National AV Center for $27.

Filmstrip

Snips and Hacksaws. Sound filmstrip, (50 frames), color, LP record, (1969), $12.25. Bailey Film Associates.

8mm Loop

Tin Snips, Chisels, and Punches. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

4.8 ABRADING CUTTING TOOLS

4.81 Files, Rasps

Files and Filing–Part IV. 16mm motion picture, black & white, minutes, $9.25. Shows variety of metal-working files and explains care and use of files. U.S. National AV Center.

Files–How To Choose and Use Them. 16mm motion picture, color, 30 minutes, loan. This film covers all types of files: American, Swiss, Vixen, and Rotary, with explanation of designs, cuts, and usage. It shows how a file works and why a proper file is important for best results. Simonds Saw and Steel Company.

Filmstrip

Files. Sound filmstrip (50 frames), color, LP record, (1969), $12.25. Bailey Film Associates.

8mm Loops

Files. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

Using the Wood File. Super 8mm loop, color, (1969), $22.75. McIntyre.

Wood Files and Rasps. Super 8mm loop, color, (1969), $22.75. McIntyre.

4.82 Papers, Stones, Belts, Wheels

Portable Electric Sander. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

Sanding Flat and Irregular Surfaces. 16mm motion picture, black & white, 19 minutes, $33.75. How the best sander operates; how to prepare a sanding belt; sand flat stock and curved molding; replace paper on disc sander and on a spindle sander. U.S. National AV Center.

8mm Loops

Abrasive Papers. Super 8mm loop, color, (1969), $22.75. McIntyre.

Belt Sander. Super 8mm loop, color, 4 minutes, (1970), $25. Demonstrates use of a belt sander and illustrates the safe procedure to follow in operating it. Ealing.

Cutting Metal and Masonry. Super 8mm loop, color, 4 minutes, (1969), $20. Demonstrates cutting corrugated metal, concrete block, composition board, and pipe. Bailey Film Associates.

4.9 MISCELLANEOUS CUTTING TOOLS

4.93 Drills

How to Use Hand Boring Tools. 16mm motion picture, color, $150. Visual Instruction.

Power Drills For Woodwork. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

Twist Drills–Part V. 16mm motion picture, black & white. 7 minutes, $12.50. Explains size designations of twist drills, cutting action, use, and how sharpened. U.S. National AV Center.

8mm Loops

Hand Boring Tools: Series. Super 8mm loop, color, (1970), $20 each. Visual Instruction. 1) Bits and Drills, 2) Chucks and Ratcheting, 3) Common Types, 4) Doweling Jig and Depth Gauge, 5) Parts of the Auger Bit, 6) Parts of the Brace Bit, 7) Their Purpose, 8) Using a Brace and Bit.

The Hand Drill. Super 8mm loop, color, (1969), $22.75. McIntyre.

Using a Swing-Brace. Super 8mm loop, color, 3 minutes, (1969), $22. Encyclopaedia Britannica.

Drilling a Hole With a Brace and Bit. Super 8mm loop, color, (1969), $22.75. McIntyre.

Publication

How To Select, Use, and Care for Wood Bits. Booklet, 30 pages, free. Irwin Auger Bit Company.

4.94 Bars, Punches, Drifts

Care and Use of Hand Tools–Part V.–Bars, Punches, and Drifts. 16mm motion picture, black & white, 14 minutes, loan. Serina Press.

INSTRUCTIONAL CODE NO. 5

Fastening and Assembling

FASTENING CHARACTERISTICS OF MATERIALS
WOODS
Instructional Code 5.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of wood that contribute to safe, effective, permanent, and quality fastening to like or other materials.	Evaluate characteristics of wood that govern the selection of fastening methods and tools in construction: 1. Friction–fibre and moisture holding power 2. Relative hardness–easily penetrated 3. Surface, texture, bonding ability 4. Splitting tendency 5. Relative time to fasten 6. Tools and machines required 7. Weight	Prepare charts showing fastening characteristics of all materials listed. Conduct controlled tests of wood reaction to various fastening methods.

FASTENING CHARACTERISTICS OF MATERIALS
METALS
Instructional Code 5.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of metal that contribute to safe, effective, permanent, and quality fastening to like or other materials	Evaluate characteristics of metal that govern the selection of fastening methods and tools in construction: 1. Surface–bonding ability 2. Relative time to fasten 3. Tools and machines required 4. Relative weight 5. Thickness 6. Hardness 7. Reaction to moisture, weather, other materials Relate the above characteristics to specific types of metals: 1. Sheet metals 2. Steel shapes 3. Architectural shapes 4. Pipe and fittings 5. Structural steel 6. Reinforcing steel	Prepare charts showing fastening characteristics of all materials listed. Conduct controlled tests of metal reaction to various fastening methods.

FASTENING CHARACTERISITCS OF MATERIALS
PLASTICS
Instructional Code 5.13

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of plastic products that contribute to safe, effective, permanent, and quality fastening to like or other materials	Evaluate characteristics of plastic materials that govern the selection of fastening methods and tools in construction: 1. Hardness 2. Surface–shape, texture, bonding ability 3. Weight 4. Structural strength–ability to hold fasteners 5. Hardness–splitting tendencies 6. Tools and machines required 7. Reaction to temperature changes Relate the above characteristics to specific types of plastic products: 1. Laminates–coverings 2. Vinyl sheets and tiles 3. Pipe and fittings 4. Insulation 5. Wall coverings 6. Panels–wall and roofing	Prepare charts showing fastening characteristics of all materials listed. Conduct controlled tests of plastics reaction to various fastening methods.

FASTENING CHARACTERISTICS OF MATERIALS
MISCELLANEOUS MATERIALS
Instructional Code 5.14

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of following construction products that contribute to permanent fastening to like or other materials: 1. Glass 2. Tiles 3. Coverings 4. Paper 5. Clay 6. Fabrics	Evaluate the composition of and characteristics of various construction products that govern the selection of fastening methods: 1. Size 2. Weight 3. Structural strength 4. Tools and machines required 5. Reaction to weather, temperature 6. Hardness 7. Surface–bonding ability	Prepare charts showing fastening characteristics of all materials listed. Conduct fastening tests of various materials with various fasteners.

SELECTION OF FASTENERS
WOODS
Instructional Code 5.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of fasteners most appropriate for permanent fastening of wood to like and other materials: 1. Drive in types 2. Screw in types 3. Clamp on, bands 4. Bolts 5. Glues, cements	Identify the normal fasteners for various types of installations: 1. Rough framing and sheathing 2. Forming and temporary fastening 3. Finish fastenings 4. Cabinets fastenings 5. Woods to other materials: Metals Plastics Evaluate and select possible fasteners with respect to: 1. Relative cost 2. Fastening time 3. Handling ease 4. Tools required 5. Skills required	Prepares displays of types of installations and fastening devices. Conduct controlled tests of holding power of fasteners.

SELECTION OF FASTENERS
METALS
Instructional Code 5.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of fasteners most appropriate for permanent fastening of metal to like and other materials: 1. Screw in types 2. Rivets 3. Bolts 4. Clamp on, bands 5. Welds, solder 6. Cements	Identify the normal types of fasteners for various types of installations: 1. Light–sheet metals 2. Medium–metal fabrication, shapes–angles, channels, bar stock, etc. 3. Heavy–structural steel, joining of members 4. Pipe to pipe 5. Metals to woods Evaluate and select the most appropriate fasteners for above materials, considering: 1. Relative cost 2. Skills required 3. Tools required 4. Fastening time 5. Strongest holding power	Prepare displays and charts of various types of metal fasteners.

SELECTION OF FASTENERS
PLASTICS
Instructional Code 5.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of fasteners most appropriate for permanent fastening of plastics products used in building construction to like and other materials: 1. Drive in types 2. Screw in types 3. Bolts 4. Clamp on, bands 5. Glues, cements 6. Welds, solders	Identify the usual types of fasteners used on plastic products found in building construction. 1. Sheet plastics- roof, wall panels 2. Laminated plastics 3. Pipe and fittings 4. Floor coverings 5. Insulation and blocks 6. Fixtures	Prepare displays and charts of plastic products showing fastening devices. Conduct controlled tests of the holding power of various fasteners.

SELECTION OF FASTENERS
MISCELLANEOUS MATERIALS
Instructional Code 5.24

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of fasteners most appropriate for permanent and temporary fastening of various construction products to like and other materials: 1. Glass 2. Tiles 3. Coverings 4. Paper 5. Clay 6. Fabrics	Identify the usual types of fasteners used on miscellaneous materials used in construction: 1. Glues, cements 2. Clips 3. Clamp-ons 4. Welds	Conduct exercises on selection of fasteners. Prepare displays and charts showing materials and various fastening devices.

TYPES OF FASTENERS
DRIVE-IN
Instructional Code 5.31

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of drive-in fasteners commonly found in construction: 1. Nails 2. Staples 3. Rivets 4. Drive screws	Identify the types and sizes of fasteners: 1. Nails Common Finish Casing Barbed Galvanized Cement coated Duplex 2. Staples Hammer type Gun type--spring trigger, powered Galvanized and barbed 3. Rivets Sheet metal–pop, drive Heavy metal Identify and describe the characteristics that govern selection of fasteners: 1. Thickness of materials 2. Friction factors 3. Fastening tools required 4. Relative cost 5. Finish requirements 6. Hardness of materials	Prepare charts and samples of various fastening devices. Require student selection of fastening devices to be used. Evaluate. Conduct tests of various fastening characteristics: 1. Time 2. Skills required 3. Holding power

TYPES OF FASTENERS
SCREW-IN
Instructional Code 5.32

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of screw-in fasteners commonly found in construction: 1. Wood screws 2. Lag screws 3. Machine screws 4. Sheet metal screws–self tapping screws	Identify the types and sizes of screw-in fasteners: 1. Wood screws Shape of head Length Diameter (gauge) Materials Finish 2. Lag screws Length Diameter Materials Finish 3. Machine screws Length Diameter–gauge Shape of head Threads per inch Finish 4. Sheet metal–tapping screws Length Diameter Shape of head	Prepare charts and displays of various screw-in devices.

Instructional Code 5.32
(Continued)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
	Identify and describe the characteristics that govern selection and use of screw-in fasteners: 1. Thickness of materials 2. Fastening tools required 3. Relative cost 4. Finish requirements 5. Holding strength required	

TYPES OF FASTENERS
BOLTS
Instructional Code 5.33

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of bolts commonly found in construction: 1. Machine 2. Carriage 3. Studs 4. Specialty	Identify the various types of bolts: 1. Shape of heads 2. Length 3. Diameter 4. Materials 5. Finish 6. Threads per inch	Prepare charts and displays of various bolts, along with principal and pertinent uses.
Appropriate uses of fasteners, and drilling requirements	Be able to identify and evaluate the characteristics that govern the selection and use of bolts: 1. Fastening tools required 2. Holding strength requirements 3. Relative cost 4. Finish requirements 5. Permanence	

TYPES OF FASTENERS
GLUES, CEMENT
Instructional Code 5.34 (Related Codes: 3.51, 3.52)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Most common forms of glues and cements used in building construction: 1. Use for each type 2. Limitations of each type 3. How each type is affected by: Weather Chemicals Pressure Time Wear Movement	Select and use proper bonding agents for: 1. Paneling 2. Ceiling tile 3. Wall tile 4. Floor coverings 5. Laminates 6. Roofing materials 7. Wall coverings (papers, cloths, etc.)	View films of various manufacturers of glues and cements. Collect samples of glues, cements, and bonding agents and demonstrate how each is used on various materials. Coordinate this unit with other units involving materials that are assembled with adhesives.

TYPES OF FASTENERS
WELDS, SOLDER
Instructional Code 5.35

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Uses and characteristics of brazing, welding, and soldering; the tools, materials, and skills, and the methods required	Identify the construction materials that can be fastened by use of solder: 1. Copper 2. Iron 3. Nickel 4. Lead 5. Tin 6. Zinc 7. Aluminum Identify tools required, types of solder, and flux. Compare the characteristics of brazing, welding, and soldering and select the appropriate methods to use in construction: 1. Tools required 2. Skills required 3. Strength of fastening 4. Relative cost 5. Safety hazards 6. Finish expected	Use audiovisual materials.

TYPES OF FASTENERS
CLAMP-ONS, CLIPS
Instructional Code 5.36

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of clamping and clip-on devices common to building construction: 1. Sash clips 2. Screed clamps 3. Sink frame clamps 4. Escutcheon clips 5. Panelling clips 6. Pipe-fitting clamps 7. Hose clamps 8. Ceiling tile clips 9. Lath clips	Identify and select the various clamps and clips listed. Select the proper fastener for each specific job.	Prepare charts and sample displays showing clip installations. Prepare displays of various clamps.
Principles involved in the use of clip inserts.		

TYPES OF FASTENERS
WIRE, TIES, BAND
Instructional Code 5.37

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of ties, particularly: 1. Patented form tie systems 2. Wire form ties 3. Form bands 4. Brick ties 5. Joist ties 6. Wire hangers 7. Lath ties	Identify and select components used in most popular form tie systems: 1. Walls 2. Columns 3. Slabs	Prepare mock-ups showing form tie systems. Prepare displays showing various tie systems and installations.
	Identify the various fastening devices listed.	
	Select and use an adequate gauge wire to meet the fastening need.	

FASTENING TOOLS–HAND AND POWER
CLAMPS
Instructional Code 5.41

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of clamp-type holding tools: 1. "C" clamps 2. Vise clamps 3. Hand screw clamps 4. Cable clamps	Identify and evaluate the characteristics of the clamps listed in order to make a proper selection in terms of: 1. Relative cost 2. Portability 3. Strength requirements 4. Probable damage to finish 5. Easy removal Be able to select and use the appropriate holding tools to assure that adequate, uniform pressure can be maintained without damage to the clamp and the materials.	Conduct exercises requiring selection and effective use of various clamping tools and devices.

FASTENING TOOLS–HAND AND POWER
HAMMERS
Instructional Code 5.42

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of hammers common to the various construction trades.	Identify the common types of hammers: 1. Carpenter's Curved claw Straight claw 2. Peen hammers Ball Straight Cross 3. Riveting hammer 4. Chipping hammer 5. Top maul 6. Sledges 7. Mallets Rubber Wood Plastic Evaluate the characteristics of each type of hammer so that a good selection and use can be made in terms of: 1. Principal designed use 2. Appropriate trade or craft 3. Weight 4. Type and size of handle 5. Type of striking face	Prepare charts and pictures of various types of hammers (catalogues, etc.) along with characteristics data. Require correct selection and use of hammers in shop projects.

FASTENING TOOLS–HAND AND POWER
SCREWDRIVERS
Instructional Code 5.43

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of screwdrivers Proper maintenance procedures	Identify common types of screwdrivers used in construction: 1. Tip Straight Phillips 2. Classes Plain Ratchet Offset 3. Sizes Tip size Length Shaft Handle Select and use the most appropriate screwdriver. Grind screwdriver tips straight, square, and parallel on the tip sides.	Prepare charts and displays of various types of screwdrivers. Conduct grinding exercises followed by practical work to demonstrate correct and incorrect shape of tips.

FASTENING TOOLS–HAND AND POWER
STAPLERS
Instructional Code 5.44

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of stapling tools for: 1. Panelling 2. Sheathing 3. Cabinet backs 4. Felts and papers 5. Insulation 6. Ceiling tile 7. Lathing and beads 8. Sash and millwork	Identify various staplers used in construction industry: 1. Hammer type, manual 2. Gun type, spring operated 3. Gun type, electrically operated 4. Gun type, air operated	Display manufacturers' literature (Bostitch, Doo-Fast, etc). Prepare charts and pictures of various tools, staples, and appropriate uses. Conduct controlled tests of penetrating and holding power of various staples.
Safety rules	Identify the various types of staples in use: 1. Point Divergent Chisel Step Combination 2. Size Length Width of crown Wire gauge	
	Select, load, and operate the above listed machines safely.	

FASTENING TOOLS–HAND AND POWER
WRENCHES, PLIERS
Instructional Code 5.45

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of wrenches and pliers common to construction	Identify the various wrenches and pliers usually used in building construction: 1. Wrenches Plain–open end, box end Adjustable–open end, monkey, pipe Socket 2. Pliers Combination Side cutting Diagonal cutting Adjustable jaw Long nose Select and use the above tools for specific construction jobs.	Prepare charts, pictures, etc., of wrenches and pliers common to construction along with their principal uses and the trades involved.

FASTENING TOOLS–HAND AND POWER
TROWELS, SPREADERS
Instructional Code 5.46

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of trowels and cement spreaders used by: 1. Brick mason 2. Tile setter 3. Concrete mason 4. Plasterer 5. Dry wall finisher 6. Floor layer	Identify and demonstrate use of trowels and spreading tools common to building construction: 1. Cement and plasterer's trowels 2. Metal floats 3. Plasterer's darbies 4. Brick trowels and pointers 5. Paste spreaders–linoleum paste, tile cement	

FASTENING TOOLS—HAND AND POWER
WELDERS, SOLDERING TOOLS
Instructional Code 5.47

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Procedures for joining or fusing various metals together using a choice of: 1. Soft soldering 2. Hard soldering (brazing) 3. Arc welding Safety precautions necessary for operator and other in use of arc welders	Demonstrate the proper use of soldering tools, equipment, and procedures in soft soldering: 1. Soldering iron 2. Solder tips: Cone Diamond Chisel 3. Soldering methods: Torch soldering Sweating Copper soldering Be able to prepare for, make the necessary connections, clean the metals, select welding rod, and run a bead using the arc welder. Demonstrate safety procedures and precautions in use of all welding and soldering equipment. Recognize and select welding rod appropriate for a specific job.	Have student make a simple edge or butt joint weld using arc welder.

ASSEMBLY AND INSTALLATION
Instructional Code 5.5

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and characteristics of: 1. Latch and lock sets 2. Closers and devices 3. Operable window units 4. Plumbing fixtures and trim 5. Power machines 6. Overhead door sets	Use detailed specifications, diagrams, or drawings to assemble and install various units used in construction. Relate schematic, single line diagrams or sketches to units, parts, and components. Use specifications or diagrams to select various components and fasteners, lay them out in sequential pattern, and assemble and fasten them as directed. Use diagrams, templates, or cutouts to install assembled units or sets. Clean, lubricate, or adjust to provide for smooth operation of an assembled installation.	Under close supervision, disassemble and assemble lock and latch sets. Require that a layout pattern be made for practice assembly of any type of set.

5.3 TYPES OF FASTENERS*

5.31 Drive In–Nails, Staples, Rivets

Common and Finishing Nails. Super 8mm loop, color, (1969), $22.75. McIntyre.

Publication

Nails and Nailing. Booklet, free. Types of nails, use requirements, types and designs recommended, size specifications and quantities required for western red cedar siding. Western Red Cedar Lumber Association.

5.32 Screw In–Screws

Screws. Super 8mm loop, color, (1969), $22.75, McIntyre.

5.33 Bolts

Bolts. Super 8mm loop, color, (1969), $22.75. McIntyre.

5.34 Glues, Cements

Franklin's Tips for Selecting the Right Adhesives. Booklet, free. Franklin Glue Company.

5.35 Welds, Solder

Soldering. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

5.36 Clamp-Ons, Clips

Catalog, free. The No. 20 catalog lists the widest selection of "clamps" available, also illustrates the correct methods of using and caring for clamps (many instructors make use of the detailed text and instructive illustrations). Adjustable Clamp Company.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

5.4 FASTENING TOOLS, HAND AND POWER

5.42 Hammers

Hammers. 16mm motion picture, black & white, 11 minutes, $19.25. Explains care and use of major types of hammers. U.S. National AV Center.

How to Use Hammers. 16mm motion picture, color, (1970), $150. Visual Instruction.

8mm Loops

Hammers. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

Hammers: Series. Super 8mm loop, color, (1970), $20 each. Visual Instruction. 1) Common Types, 2) Driving a Nail, 3) Parts of the Claw Hammer, 4) Procedures in Safety, 5) Removing a Nail, 6) The Nail Set, 7) Their Purpose.

5.43 Screwdrivers

Pliers and Screwdrivers. 16mm motion picture, black & white, 15 minutes, $27. Demonstrates proper and safe use of pliers and screwdrivers. U.S. National AV Center.

Filmstrip

Automatic Screwdriver. Sound filmstrip, color, (53 frames), LP record, $12.25. Bailey Film Associates.

8mm Loop

Screwdrivers. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

5.45 Wrenches, Pliers

Care and Use of Hand Tools–Part I–Wrenches. 16mm motion picture, black & white, 20 minutes, loan. Serina Press.

Care and Use of Hand Tools–Part II–Pliers and Screwdrivers. 16mm motion picture, black & white, 14 minutes, loan. Serina Press.

Wrenches. 16mm motion picture, black & white, 19 minutes, $33.75. Explains uses and advantages of various wrenches. U.S. National AV Center.

Filmstrips

Pliers, Part I and II. Sound filmstrips (50 frames each), color, LP record, $12.25 each. Bailey Film Associates.

Socket Wrenches. Sound filmstrip, (50 frames), color, (1969), $12.25. Bailey Film Associates.

Pliers. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

Wrenches: Adjustable, Open Box End, and Socket. Super 8mm loop, color, 4 minutes, (1969), $20. Bailey Film Associates.

5.47 Welders, Solder Tools

Hand Soldering. Super 8mm loop, color, $20. Sterling Educational Films.

Soldering Equipment. Super 8mm loop, color, $20. Sterling Educational Films.

Tinning An Iron. Super 8mm loop, color, $20. Sterling Educational Films.

Tinning Metal. Super 8mm loop, color, $20. Sterling Educational Films.

5.5 INSTALLATION

5.51 Assembly of Components

Casting and Erecting Concrete Curtain Walls. 16mm motion picture, color, 21 minutes, (1960), loan. A brief review of several methods of casting concrete decorative panels at the site and in the casting yard. The film shows several types of surfaces, including exposed aggregate, sand sculpture, and smooth surfaces obtained by use of plastic form liners. It concludes with a sequence on methods that contractors use to fasten curtain wall panels to building frames. Modern Talking Picture Service.

Particleboard Out of Sight and Underfoot. 16mm motion picture, color, 12 minutes, free loan or purchase for $110. Instruction for properly installing floor underlayment using particleboard. National Particleboard Association.

8mm Loop

Selecting the Door. Super 8mm loop, color, (1970), $20. Visual Instruction.

Publication

Prevent Splitting Accidents, Use Proper Nailing Practices. Booklet, free. Where to nail, what to use, and when. Western Wood Products Association.

5.52 Installation and Operational Check

How to Hang a Door. 16mm motion picture, color, (1970), $150. Visual Instruction.

8mm Loop

Installing Butts and Swinging the Door. Super 8mm loop, color, (1970), $20. Visual Instruction.

Multimedia

How to Hang a Door. (series 2) Multimedia, (1970), $250. Visual Instruction.

5.53 Holding–Fastening

Fastening Metals. 16mm motion picture, color, 13 minutes, (1967), $150. Sterling Educational Films.

Hammer and Nails. 16mm motion picture, color, 12 minutes, (1967), $150. Sterling Educational Films.

Transparency

Nailing Roof Boards. Transparency, $2.75, GAF Reprographic.

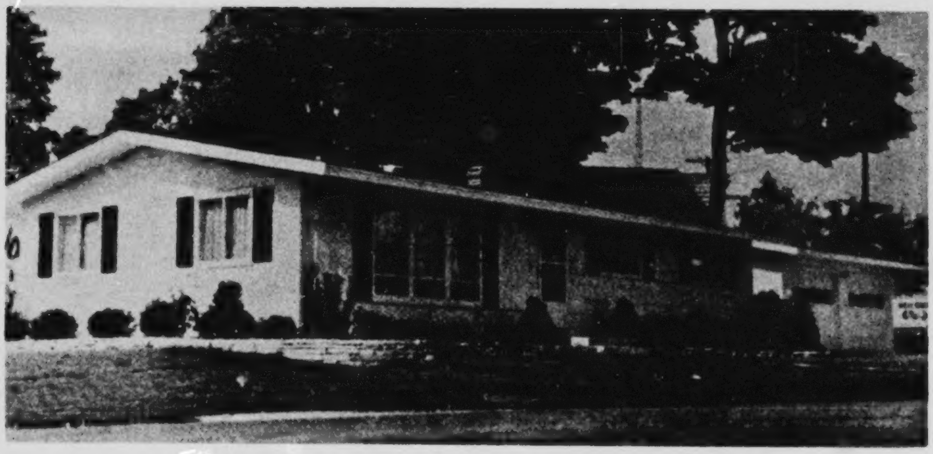
8mm Loops

Fastening Metals: Series. Super 8mm loop, color, (1967), $20 each. Sterling Educational Films. 1) Fasteners and Correct Size Holes, 2) Preparing Holes, 3) Riveting, 4) Screws and Bolts. 5) Spot Welding.

The Nail Set: Setting and Hiding a Nail. Super 8mm loop, color, (1969), $22.75. McIntyre.

Preparation for Gluing. Super 8mm loop, color, (1969), $22.75, McIntyre.

Techniques of Nailing. Super 8mm loop, color, (1969), $22.75. McIntyre.



INSTRUCTIONAL CODE NO. 6

Finishing

FINISHES–CATEGORIES, CHARACTERISTICS
PROTECTIVE
Instructional Code 6.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of finishes to be applied primarily for protection in building construction: 1. Moisture barriers 2. Rust inhibitors 3. Waterproofing 4. Wear resistants 5. Heat resistants	Select types of products for various protective functions: 1. Moisture barrier and waterproofing Emulsions Masonry paints Asphalt coatings Cement finishes 2. Rust inhibitors Aluminum paints Red lead 3. Wear resistants Various enamels Cement finishes 4. Heat resistants Asbestos coatings Aluminum paints Black enamel Identify characteristics of various products that affect their selection and use: 1. Application methods 2. Relative cost 3. Relative efficiency 4. Durability 5. Appearance	Prepare charts and diagrams in conjunction with decorative and functional finishes showing various types of products along with pertinent characteristics. Collect working files of manufacturers' literature and match with above charts.

FINISHES—CATEGORIES, CHARACTERISTICS
DECORATIVE
Instructional Code 6.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of decorative, protective finishes, methods of application, and tools and equipment required for: 1. House and building exterior walls and trim 2. Interior ceiling and walls 3. Interior floors 4. Interior trim and fixtures 5. Natural woods 6. Exterior floors and decks	Be able to select and apply the various decorative finishes for their appropriate functions: 1. Casein paints 2. Deck paints 3. Enamel and undercoat 4. Floor sealer 5. Exterior house paint—oil and latex 6. Lacquer 7. Interior oil paints 8. Interior latex paints 9. Masonry paints 10. Shellac 11. Varnish Identify characteristics of various products that affect their selection and use: 1. Application methods 2. Relative cost 3. Durability 4. Type of finish desired 5. Appearance 6. Protective values	Prepare charts and diagrams in conjunction with decorative and functional finishes showing various types of products along with pertinent characteristics. Collect working files of manufacturers' literature and match with above charts.

FINISHES—CATEGORIES, CHARACTERISTICS
FUNCTIONAL
Instructional Code 6.13

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of products, and methods of application of building construction products used primarily for functional purposes: 1. Insulating finishes 2. Acoustical finishes 3. Safety finishes 4. Abnormal wear finishes 5. Fire retardant finishes	Select general types of products for various functional purposes: 1. Insulating Plasters Paints Aluminum Paper Cork Plastics 2. Acoustical Cellulose fibers Paints Plasters Minerals 3. Safety finishes Paint colors Anti-slip, skid finishes 4. Fire retardant finishes Paints Plasters Gypsum products 5. Abnormal wear finishes Paints Carborundum materials	Prepare charts and diagrams in conjunction with decorative and functional finishes showing various types of products along with pertinent characteristics. Collect working files of manufacturers' literature and match with above charts.

Instructional Code 6.13
(Continued)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
	Identify characteristics of various products that affect their selection and use: 1. Application methods 2. Relative cost 3. Durability 4. Appearance 5. Tools and skills required 6. Relative functional values	

PREPARATION OF SURFACES AND MATERIALS
WOODS
Instructional Code 6.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics peculiar to wood and wood products that affect their finish. The preparations that contribute to quality finishes.	Evaluate the characteristics of wood and wood products that govern the selection of finishes and the application conditions: 1. Appearance Texture Grain Colors, shades 2. Moisture content 3. Surface Knots, pitch pockets, etc. Grain direction, density Smoothness 4. Density–porosity Be able to perform all steps necessary for preparing woods and wood products for finish coating; 1. Sanding Smoothing Eliminating discoloration and marks 2. Filling and smoothing holes, cracks, and blemishes 3. Removing dust and foreign objects	Conduct supervised exercises requiring step by step preparation of woods for finishing. Prepare display samples of various wood products showing stages of finish preparation and application.

PREPARATION OF SURFACES AND MATERIALS
METALS
Instructional Code 6.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics of metal products that affect their finish Preparations that contribute to a quality finish	Evaluate the characteristics of metal products that govern the selection of finishes and the application conditions: 1. Density–porosity 2. Reaction to moisture 3. Chemical reaction 4. Bonding 5. Surface Perform the steps necessary for preparation of metal products for finishing: 1. Grinding 2. Cleaning 3. Priming/sealing	Conduct supervised exercises requiring step-by-step preparation of metals for finishing. Prepare display samples of various metal products showing stages of finish preparation and application. Prepare charts showing various types of metal products used in building construction and types of finish products used on each.

PREPARATION OF SURFACES AND MATERIALS
MISCELLANEOUS MATERIALS
Instructional Code 6.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Characteristics that affect the finish of the following materials used in construction: 1. Plastics 2. Paper products 3. Gypsum products 4. Clay and pumice brick and block 5. Concrete Preparations that contribute to quality finish.	Evaluate the characteristics of the various products that govern the selection of finishes and the application conditions: 1. Appearance 2. Surface texture 3. Density–porosity 4. Reaction to moisture 5. Chemical reaction 6. Bonding	Prepare display samples of various products showing stages of finish preparation and application.

PREPARATION OF SURFACES AND MATERIALS
FILLERS, CAULKING, WEATHERPROOFING
Instructional Code 6.24

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Materials, application methods and tools used in filling and weatherproofing, particularly at: 1. Construction joints 2. Door, window, vent openings	Identify and select construction joint protective measures: 1. Plastic type caulks 2. Cemented sealers 3. Sealer paints 4. Insulation materials Rubber Leather Paper Plastics	Conduct exercises involving neat and tight use of caulking gun. Survey conditions around the exterior of the shop area to determine weatherproofing adequacy.
Methods of providing protection against wind, moisture, drifting snow, temperature changes, both hot and cold.	Be able to select and use a caulk and caulking gun to provide a tight, neat joint ready for final finish. Determine those areas requiring protection prior to finishing.	

FINISHING TECHNIQUES
Instructional Code 6.3

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Basic principles of applying finish materials to insure quality in appearance and texture. Typical finishes to include: 1. Paint 2. Varnish 3. Prefinished products 4. Panelling 5. Ceiling tiles 6. Papers 7. Fixtures and trim 8. Floors and counter tops	Apply finish materials so as to: 1. Protect adjoining surfaces, such as floors, trim, woodwork, etc. 2. Eliminate dust and dirt to avoid implanting into the finish 3. Omit marks, smudges, and other unsightly surfaces 4. Eliminate weather, temperature and moisture factors that will have a bearing on the quality of the finish Demonstrate various finishing techniques that will assist in obtaining quality work: 1. Use of dropcloths 2. Use of coverings 3. Careful handling of products that have a staining capability 4. Cleanliness of person, tools, and surrounding area 5. Careful planning of sequential steps	Supervise student preparations for and application of finishes. Point out the results of either good or bad techniques used on individual student projects.

FINISHING TOOLS
ABRASIVES, GRINDERS
Instructional Code 6.41

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Selection and use of abrasives and abrasive tools and machines in finishing: 1. Woods and wood products 2. Metal products 3. Concrete products	Identify the various abrasives and abrading tools used for finish work: 1. Abrasive papers, cloths, wheels 2. Files, rasps 3. Portable grinders Select appropriate abrasive materials for given types of finishing. Use abrasives and abrasive tools and machines to obtain quality finishes: 1. Without undue scratches or cuts on the finished surface 2. Without undue wear on the abrasive and machine 3. In reasonable working time	Supervise student preparations for and application of finishes. Point out the results of either good or bad techniques used on individual student projects.

FINISHING TOOLS
BRUSHES, ROLLERS
Instructional Code 6.42

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of finishing tools or application of liquid products to surfaces	Identify the various brushes and rollers commonly used in construction and describe the uses of each: 1. Brushes Bristle Nylon 2. Size and shape Shaped trim brushes Varnish brushes Enamel brushes Flat paint brushes 3. Rollers Felt Fleece Pile carpeting–fine or coarse Select and use the appropriate tool for specific types of finishing: 1. Interior Trim; ceiling, walls, cabinets 2. Exterior Trim; siding, masonry	Prepare charts and displays of various types of brushes and rollers and recommended uses.
Proper maintenance techniques	Be able to clean and store finishing tools so as to provide for complete removal of materials and retain original shape. Select and use appropriate solvents.	Conduct supervised cleaning classes.

FINISHING TOOLS
SPRAYS
Instructional Code 6.43

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of spraying tools and equipment	Identify the spray tools used for: 1. Lacquers 2. Paint and enamel 3. Texture coatings	
Application techniques	Demonstrate the correct use of spray equipment, including: 1. Protective measures for residual spray problems 2. Methods for obtaining purity and correct thickness of liquid to be applied 3. Operation of spray gun to achieve coverage without runs, orange peeling, or streaks	
Proper maintenance procedures	Disassemble a spray head and completely remove all traces of materials used; clean and maintain tanks, hoses, and other equipment.	

FINISHING TOOLS
BUFFERS, POLISHERS
Instructional Code 6.44

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types and uses of buffing and polishing tools for lacquer, varnish, and wax finishes	Apply waxes or appropriate finishes and select and operate the appropriate polishing tool, considering: 1. Size and type of tool needed 2. Appropriate selection of buffer material 3. Safety 4. Amount of buffing necessary 5. Potentials for damaging the finish or adjacent surfaces Determine the appropriate time for applying buffing type finishes to insure. No damage to or interference with other work under way. No damage to the surface awaiting the finish.	

FINISHING TOOLS
TROWELS
Instructional Code 6.45 (Related Code: 5.46)

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of trowels and their uses: 1. Cement finishing 2. Plastering 3. Dry wall taping and finishing	Identify the various types of trowels used in finishing: 1. Cement Float Finish trowel Edgers Step Corner Jointer 2. Plaster Float Finish trowel Featheredge 3. Dry wall Finish trowel Joint knives Finish knives Use various types of troweling tools to: 1. Apply a smooth coat of finish material 2. Eliminate rough spots, bubbles, edges 3. Smooth to desired hardness	Prepare charts and displays showing types of tools and uses for each. Use audiovisual materials.

INSTRUCTIONAL MATERIALS

6.1 FINISHES–CATEGORIES, CHARACTERISTICS*

6.11 Protective

Linseed Oil for Wood Finishing. Super 8mm loop, color, (1969), $22.75. McIntyre.

6.12 Decorative

New Dimensions in Design. Mounted slide set (24 frames), color, 24 veneer samples, 1 hour script, loaned free or purchase for $5. Lecture on veneer-matching technique for wall paneling, with suggestions for paneling homes, commercial and public buildings. Fine Hardwoods Association.

6.2 PREPARATION OF SURFACES AND/OR MATERIALS

6.21 Woods

Feel the Difference. 16mm motion picture, color, 26 minutes, loan. This film shows how Furniture-Finished Wall Paneling fits a multitude of uses in beautifying homes and offices. It shows the steps in the manufacture and finishing of hardwood plywood, with a variety of woods from many parts of the world. United States Plywood Corporation.

8mm Loops

Steel Wool in Woodworking. Super 8mm loop, color, (1969), $22.75. McIntyre.

Using Abrasive Papers. Super 8mm loop, color, (1969), $22.75. McIntyre.

6.22 Metals

Free catalogs, bulletins, and pamphlets are available at no cost to instructors concerned with metal buffing, surface finishing, and polishing. The Lea Manufacturing Company.

6.23 Miscellaneous Materials

Painting and Decorating: Paperhanging Preparation. 16mm motion picture, color, 14 minutes, $150. Sterling Educational Films.

6.3 FINISHING TECHNIQUES

How to Transport, Place, Finish, and Cure Quality Concrete. 16mm motion picture, color, 32 minutes, (1954), loan. This is a companion film to *The Principles of Quality Concrete.* It takes a proper mix of concrete from the mixer by means of buggies, buckets, chutes, trucks and pipes to the point of placement; shows approved placing methods in horizontal and vertical forms; demonstrates proper finishing techniques for slabs of all types and vertical walls; and concludes with a variety of concrete curing methods with particular emphasis on winter protection. Modern Talking Picture Service.

Painting and Decorating: The Art of Painting a Door. 16mm motion picture, color, 12 minutes, $150. Sterling Educational Films.

6.4 FINISHING TOOLS

6.41 Abrasives, Grinders

Filing Wood. Super 8mm loop, color, 4 minutes, (1969), $20. McGraw-Hill.

Smoothing With Abrasive Paper. Super 8mm loop, color, 4 minutes, (1969), $20. McGraw-Hill.

6.43 Sprays

Airless Spray, A Modern Application Method. 16mm motion picture, color, 11 minutes, loan. General information on airless spray painting equipment and its most beneficial applications. The DeVilbiss Company.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

Glass Fiber Spray-Up Method. 16mm motion picture, color, 10 minutes, loan. Equipment for glass fiber and resin deposition in both spray-up perform operations. The DeVilbiss Company.

Making the Most of the Spray Painting Method. 16mm motion picture, color, 45 minutes, loan. This film shows how spray equipment works; the types of equipment and their adjustment, the elements of the spraying machines and their functions; it also shows how to use spray equipment, how to care for the equipment, and the cleaning of the gun, booth, hose, and containers. It includes the locating and correcting of common defects. The DeVilbiss Company.

Ransburg Electrostatic Painting. 16mm motion picture, color, 22 minutes, loan. This film shows a product-eye view of Ransburg electrostatic painting. It shows, from a few inches away, how electrostatic force literally wraps paint around the work without waste. All sizes and shapes of objects are shown on actual painting lines, using the type of Ransburg equipment (disk, bell or hand gun) best suited to that type of work. Also included is electrostatic spray equipment for application of dry powders and equipment for electrophoresis coating. Ransburg Electrocoating Corporation.

An Up-To-Date Appraisal of Conventional and Hot Spray Painting Methods. 16mm motion picture, color, 15 minutes, loan. General information on conventional and hot spray equipment and its most useful and beneficial application. The DeVilbiss Company.

Publications

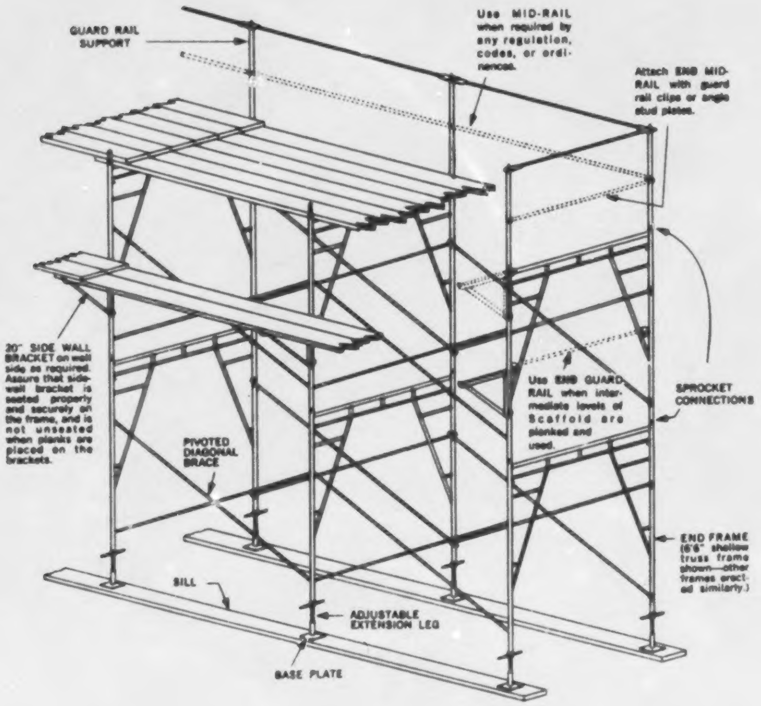
ABC's of Spray Equipment. Booklet, 64 pages, free. A booklet of spray equipment ABC's. The DeVilbiss Company.

F-273: Making the Most of Spray Painting Methods. Booklet, free. To be given to the audience at each showing of film. The DeVilbiss Company.

F-274: Airless Spray. Booklet, free. Summarizes *Airless* movie. The DeVilbiss Company.

F-275: Conventional Spray. Booklet, free. Summarizes *Conventional and Hot Spray* movie. The DeVilbiss Company.

Spray Gun Motion Study. Booklet, 15 pages, free. Explains spraying techniques. The DeVilbiss Company.


GUARD RAIL SUPPORT
Use MID-RAIL when required by any regulation, codes, or ordinences.
Attach END MID-RAIL with guard rail clips or angle stud plates.
20" SIDE WALL BRACKET on wall side as required. Assure that side-wall bracket is seated properly and securely on the frame, and is not unseated when planks are placed on the brackets.
Use END GUARD RAIL when intermediate levels of Scaffold are planked and used.
SPROCKET CONNECTIONS
PIVOTED DIAGONAL BRACE
END FRAME (6'6" shallow truss frame shown—other frames erected similarly.)
SILL
ADJUSTABLE EXTENSION LEG
BASE PLATE

INSTRUCTIONAL CODE NO. 7

Safety

LADDERS AND SCAFFOLDS
SAFETY CODES
Instructional Code 7.11

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Safety restrictions imposed by National Safety Code, and Oregon Safety Codes for Ladders and Scaffolds, including: 1. Placement 2. Construction 3. Use 4. Storage and maintenance	Describe the safety codes criteria applied to ladders and scaffolds: Ladders 1. Allowable construction materials 2. Step spacing 3. Width and height of ladders 4. Dimension of side rails, steps, cleats 5. Extension ladder height and overlap 6. Types and permitted uses of ladders 7. Placement of ladders	Research exercises in developing specific reasons for the various code restrictions.
Basic safety principles involved in the code restrictions.	Scaffolds 1. Allowable construction materials 2. Minimum width 3. Planking 4. Guard rails 5. Bracing 6. Splicing of poles 7. Ledgers 8. Bearers 9. Dimensions related to height and lead 10. Types and permitted uses of scaffolds	

LADDERS AND SCAFFOLDS
CONSTRUCTION, USES, TYPES
Instructional Code 7.12

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Methods of erecting or assembling the type of ladder or scaffold needed for various construction jobs	Design, construct, and erect various job ladders and scaffolds that meet safety requirements: Ladders 1. Single portable ladders 2. Fixed ladders 3. Extension ladders (erect) 4. Ladder jacks (erect) Scaffolds: 1. Single pole 2. Independent 3. Bracket 4. Window jack	Have students build portable ladders for home or school use. Design and construct scaffolds around portions of the school building. Ask for qualified safety inspection. (Either state or safety engineers.)

HOISTING AND LIFTING SAFETY CODES

Instructional Code 7.21

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Safety restrictions of State of Oregon and National Safety Council as they apply to off-the-ground materials handling Safety principles involved and accepted techniques followed in safe materials handling in construction Methods of rigging and operating simple and safe hoist mechanisms	Set and operate hoisting equipment, demonstrating: 1. Height and weight limitations 2. Personal protection requirements 3. Safe load lashing 4. Universal signals 5. Limitations on use 6. Enclosure of equipment 7. Types of allowable hoists 8. Braking requirements 9. Inspections required Set up and operate a single pulley 'A' frame hoist capable of lifting a given weight up to a given height. (1000 pounds to eight feet, for example.)	Research exercises in the different types of hoisting equipment used by building construction trades. Set up a simple A frame hoist and ask for safety inspection.

HOISTING AND LIFTING
RIGGING
Instructional Code 7.22

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Types of rope and uses of each for lifting and rigging	Tie and use the following rigging knots: 1. Square knot 2. Single sheet bend 3. Double sheet bend 4. Overhand knot 5. Figure eight 6. Bowline 7. Running bowline 8. Bowline on a bight 9. Speir 10. Scaffoid hitch 11. Clove hitch 12. Timber hitch 13. Half hitch 14. Double half hitch 15. Snubbing hitch 16. Barrel hitch 17. Becket hitch 18. Catspaw hitch	Design and test various block and tackle combinations using given weights.
Knot terms and tying		Tie various knots and test in their designed use.
Uses of cable clamps, straps, and chokers for safe lifting	Rig and use a choker for lifting cylindrical and bulky objects.	
Characteristics of rigging–block, block and tackle, combinations of blocks	Rig simple block and tackle; compound tackle ranging from equal load and pull to a ration of 8 to 1 in load and pull.	

HOISTING AND LIFTING SIGNALS
Instructional Code 7.23

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Standardized signals for handling construction materials	Understand and use basic hand signals for crane or hoist, including signals to: 1. Raise load 2. Lower load 3. Stop 4. Swing 5. Boom up 6. Boom down 7. Go slow 8. Make emergency stop Direct placement of a load in a designated position by using the standardized hand signals.	Set up small practice boom and conduct exercises in spotting and moving loads.

SHOP SAFETY
SAFETY CODES
Instructional Code 7.31

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Safety standards for shop activities included in: 1. HEW safety program (Appendix A) 2. State of Oregon Safety Code 3. Local and regional codes Purpose of various restrictions of activities while in shop environment.	Apply the basic provisions of various safety codes regarding: 1. Personal protective equipment 2. Good housekeeping 3. Safe working habits 4. Fire hazards 5. Clothing and personal hazards 6. Electrical hazards 7. Ventilation and sanitation hazards Demonstrate that safety habits become second nature.	Have class identify and analyze hazards and develop safety codes for their particular school and shop. Factors to be considered: 1. Grade level and experience of students 2. Machines and equipment provided 3. Extent of student usage of machines 4. Objectives of course 5. Desired safety habits

SHOP SAFETY
GENERAL SAFETY
Instructional Code 7.32

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Good safety practices in shop activities Purpose for observing and promptly reporting all safety violations and hazardous conditions and equipment	Apply local safety codes and shop rules to general shop activities, including: 1. Housekeeping 2. Care and use of hand tools 3. Use of safety equipment 4. Safety of others 5. Reporting hazards 6. Lifting and carrying Prove safety competency in written and performance tests as well as in day-to-day activities.	Appoint student safety foremen with total safety responsibilities. Require written reports, critique, rotate. Use audiovisual aids. Make lavish use of safety posters, slogans, printed cautions, etc.

SHOP SAFETY
MACHINE SAFETY
Instructional Code 7.33

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Machine hazards	Recognize machine hazards, including: 1. Broken or missing parts 2. Dull cutters 3. Loose parts or accessories Insure safety of others through: 1. Exclusion from operator area 2. Removal from danger areas 3. Correct use of helpers	Appoint student safety foremen with total safety responsibilities. Require written reports, critique, rotate. Use audiovisual aids. Make lavish use of safety posters, slogans, printed cautions, etc.

CONSTRUCTION SAFETY
SAFETY CODES
Instructional Code 7.41

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Restrictions, liability and enforcement provisions of Oregon State Safety Codes for building construction Purposes of the various safety restrictions	Identify hazardous factors in building construction jobs that place them in a high risk category: 1. Tools and machines 2. Excavations 3. Materials handling 4. Off-the-ground activities 5. Variety of concurrent activities 6. Weather factors Relate the hazardous factors to specific requirements and controls in the Oregon Safety Code. Relate the worker's legal responsibilities for safety in construction: 1. Use of safeguards 2. Reporting defective tools and equipment 3. Removal of accident prevention devices 4. Working in hazardous or exposed areas 5. Reporting hazardous conditions 6. Reporting accidents	Extract the sections of the Oregon Safety Code that apply to construction. Visit construction sites to observe safety procedures. Use safety films. Invite guest speakers—contractors, safety engineers, State Accident Commission members, etc.

CONSTRUCTION SAFETY PRACTICES
Instructional Code 7.42

REQUIRED KNOWLEDGE	EXPECTED BEHAVIORS (SKILLS) THE STUDENT WILL BE ABLE TO	SUGGESTED LEARNING ACTIVITIES
Good safety practices	Learn good safety habits in school shop that will apply to construction work; recognize and correct conditions that cause accidents: 1. Horseplay 2. Working underneath others 3. Working under overhead loads or materials 4. Careless housekeeping 5. Lack of protective devices: Hard hat Goggles Boots or shoes 6. Improper lifting 7. Poor sanitation 8. Unprotected excavations 9. Unsafe elevators and hoists 10. Unsafe scaffolds and ladders 11. Careless demolition 12. Electrical hazards	Extract the sections of the Oregon Safety Code that apply to construction. Visit construction sites to observe safety procedures. Use safety films. Invite guest speakers—contractors, safety engineers, State Accident Commission members, etc. Relate those safety practices prescribed in shop safety rules to those followed on construction sites.

7.2 HOISTING AND LIFTING*

7.21 Safety Codes

Construction: Material Hoists. Booklet, (1970), 45 cents. National Safety Council.

7.3 SHOP SAFETY

7.32 General Safety

Communications for Safety Series. 16mm motion picture, black & white, 10 minutes each, (1963), loan.

PC133	Let's Talk About Safety
PC134	Take a Talkie Break
PC135	Setting 'Em Straight
PC136	Let Everybody Help

This series offers a fresh approach to the universal problem of getting ideas across. A combination of live action–featuring actors who look and talk like foremen–and animated cartoon, it shows foremen how to use plain talk to put safety across, how to talk safety as easily as they talk bowling or baseball. Modern Talking Picture Service.

Fatal Accident Report. 16mm motion picture, color, 32 minutes, (1963), loan. This film is the reenactment and analysis of an actual fatal electrical accident. It presents accident prevention principles applicable to all people in a supervisory capacity. Modern Talking Picture Service.

Growing Pains. 16mm motion picture, color, 33 minutes, (1959), loan. A short drama with a cement mill setting in which a new employee discovers that indifference to accident hazards is "kid stuff." An amusing flashback shows how one of the plant's safest workers, through painful and embarrassing experiences, grew up to accept his responsibilities for observing rules and instruction, maintaining discipline, and working with fellow employees as a team to keep his plant free from accidents. Modern Talking Picture Service.

Fragile–Handle Feelings With Care. 16mm motion picture, black & white, 10 minutes, (1963), loan. This film features the antics of a foreman named Gus O'Grady whose fumbling, fuming, and funny misadventures offer foremen plenty of basic lessons on dealing with workers. The ideas presented are sound, usable human relations techniques. Modern Talking Picture Service.

How to Avoid Muscle Strains. 16mm motio picture, color, loan. This film employs views of a living model in action, also animated drawings to illustrate the mechanics of muscular activity especially in lifting heavy objects. Shown also are correct and incorrect ways of lifting objects and effects of overstrain on cerebral column. Concluding section deals wth the difficult subject of hernias. Bray Studios, Incorporated.

Key Man Series. 16mm motion picture, black & white, 10 minutes each, (1961), loan.

PC125	Point of No Return
PC126	You're the Key Man
PC127	It's the Little Things That Count
PC128	People Are the Puzzle

Produced by the National Safety Council. This series of four films shows the need of supervisors to understand the people who work for them. It outlines reasons for a foreman to make safety a definite part of his responsibilities. It also points out that safety is a team effort of management, foreman, and employee. Modern Talking Picture Service.

Safety and the Foreman Series. 16mm motion picture, black & white, 13 minutes each, (1961), loan.

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*Complete mailing addresses of all media producers and distributors are listed in Appendix C.

PC129	No One Else Can Do It
PC130	Fact Finding, Not Fault Finding
PC131	Foresight, Not Hindsight
PC132	What They Don't Know Can Hurt

Produced by the National Safety Council. Series of four films dealing with supervisory techniques in employee relations. Modern Talking Picture Service.

Safety in the Shop: Basic Practices. 16mm motion picture, color, 14 minutes, (1970), $6.50 rental. The worker's responsibility for safety in use of hand and power tools in both wood and metal shops. Audiovisual Instruction.

Safety in the Shop: Hand Tools. 16mm motion picture, color, 12 minutes, (1970), $6.50 rental. The value in both wood and metal shops of keeping hand tools in good condition. The importance of sharp saws and chisels, repairing broken handles, and replacing worn parts. Audiovisual Instruction.

Safety in the Shop: Power Tools. 16mm motion picture, color, 13 minutes, (1970), $6.50 rental. Safety practices in the use of woodworking and metalworking machines. The need for proper clothing, machine guards, and proper equipment adjustments. Audiovisual Instruction.

Safety Zone. 16mm motion picture, color, 27 minutes, loan. Depicts preventive and corrective action vital to any plant safety program. Gypsum Association.

Filmstrips

Safety in the Shop. Filmstrip (50 frames), color, (1969), $7. McGraw-Hill.

Shop Safety. Six sound filmstrips, color, 3 LP records, (1971), $50. Coronet Films. 1) Think Safety; 2) General Shop Hazards; 3) Handsaws, Chisels, and Files; 4) Screwdrivers, Wrenches, Sheetmetal, and Welding; 5) Grinders, Routers, Power Saws, and Jointers; 6) Drill Presses and Lathes.

Publication

Free poster series. Colorful eye safety poster series, educational supply catalog, and labels: *Wear Goggles When Operating.* McKilligan Supply.

7.33 Machine Safety

New Approach to Table Saw Guarding. 16mm motion picture, color, 15 minutes, loan. This film presents a demonstration by an instructor. It shows how the Brett-Guard provides a safe and efficient, fully adjustable method of making various heretofore impossible to guard types of cuts with complete visibility. All usual cuts are fully protected. Brett-Guard Corporation.

8mm Loops

Using a Circular Saw Safely. Super 8mm loop, color, 4 minutes, (1969), $19.50. CENCO Educational Aids.

Wood Shop–Safety and Operation Series. Super 8mm loops, color, $25 each. Aims Instructional Media. 1) Safety Demonstration on the Bandsaw, 2) Safety Demonstration on the Jointer, 3) Safety Demonstration on the Radial Saw, 4) Safety Demonstration on the Shaper I, 5) Safety Demonstration on the Shaper II, 6) Safety Demonstration on the Single-Surface Planer, 7) Safety Demonstration on the Table Saw I, 8) Safety Demonstration on the Table Saw II.

Publications

Chart, 17 inches x 22 inches, sets of 20, $4. Charts cover both portable and stationary tools, and contain nomenclature, operating and safety suggestions. They are printed in two colors, mounted on heavy box board with two brass gromments for hanging. The surface is also coated with varnish making them durable and easy to clean. Rockwell Manufacturing Company.

Power Woodworking Tools. Booklet, 30 pages, 10 cents. Safety rules for safe operation. Written in easy to understand manner. Ideal for student use. Paxton Equipment and Supply.

APPENDIX A

AN ACCIDENT PREVENTION PROGRAM
FOR
SCHOOL SHOPS AND LABORATORIES

U.S. Department of Health, Education and Welfare
Office of Education

Safety Inspections

Use a safety check list to assure that all safety factors are checked during safety inspections.

Use the American Vocational Association-National Safety Council's "National Standard School Shop Safety Inspection Check List" during shop safety inspections.

Have frequent safety inspections of the shop made by

a. School personnel – state and/or local level

b. A student safety committee

c. A student inspector or foreman

d. Industrial safety engineers

e. Inspectors from the state departments of labor and industry

f. State fire inspectors

Rotate assignments of students to the shop safety committee.

Rotate assignments of students as safety inspectors or safety foremen.

Accident Reports

Require students to report all accidents to the teacher, regardless of nature or severity.

Keep a record of all shop accidents resulting in injury to students, regardless of nature or severity.

Analyze all accident reports for the purpose of aiding in the prevention of other accidents.

Use a printed or duplicated form to record the details of shop accidents.

Make a report to the school administration on all shop accidents resulting in injury to students, regardless of nature or severity.

6. Prepare a monthly summary of all accidents in the shop for the director or principal for inclusion in a composite summary of all accidents in the school.

Instructional Techniques

1. Develop a permanent safety consciousness in students through teacher example – always doing things the safe way.
2. Teach accident prevention with a positive approach – stressing the right way to perform an operation.
3. Give shop demonstrations emphasizing the safe use of hazardous machines.
4. Give shop demonstrations emphasizing the safe use of specific hand tools.
5. Present safety instruction with the following objectives in mind:
    a. Developing in each student a sense of responsibility for his own safety and that of others.
    b. Helping students understand that the safe way of doing things is effective.
    c. Helping students recognize situations involving hazards.
    d. Helping students learn safe practices to use in their own day-to-day activities.
6. Provide instruction on what to do in case of a shop accident.
7. Use information sheets dealing with the safe use of specific hand tools.
8. Use information sheets dealing with the safe operation of hazardous machines.
9. Give periodic shop demonstrations on the proper use and care of personal protective devices.

10. Use information sheets dealing with the general safety rules of the shop.

11. Provide for safety instruction in the course of study.

12. Provide instruction in the maintenance of shop tools, machines and other equipment.

13. Provide instruction in the safe methods of lifting and/or moving heavy equipment or other loads.

14. Provide a bulletin board for safety bulletins, safety posters, and safety rules and regulations.

15. Give periodic shop talks to emphasize the importance of each student acquiring the proper attitude toward accident prevention.

16. Conduct field trips to industrial plants or construction jobs to study safety practices.

17. Send letters to parents when a student has exhibited a great degree of interest in safety or when he has successfully applied safety practices to handle a shop situation.

18. Require all beginning shop students to make a careful study of hazards in the shop during the first few days of the course.

19. Provide a safety suggestion box for student use.

20. Provide for visiting speakers from business and industry to speak on occupational safety and health practices.

21. Prepare a written safety education program for the shop — similar to a course of study.

22. Require each student to sign information sheets dealing with shop safety rules and regulations to indicate that he has read and understood the information. These sheets should be kept on file until the student completes his course of instruction.

23. Prepare a written safety education program for the shop and submit to the school administration for their information.

Equipment Care and Operation

1. Enclose all gears, moving belts, and other power transmission devices with permanent guards or barricades.

2. Permit each student to operate a hazardous machine only after demonstrating his ability to operate the machine safely.

3. Require a signed statement from a parent granting permission for students to operate power machines.

4. Permit students to operate a hazardous machine only after passing an examination on the safe operation of the machine.

5. Provide an operator's card or license to each student who successfully completes the necessary qualifications to operate power-driven machines.

6. Require that all hand tools are kept sharp, clean, and in safe working order.

7. Prohibit students from operating hazardous machines when the instructor is not present.

8. Prohibit the use of any defective tools, machines, or other equipment.

9. Maintain strict supervision of students who are using hazardous machines and dangerous tools.

10. Prohibit the removal of guards and safety devices, even for a brief interval, without the approval of the teachers.

11. Prohibit students not enrolled in shop classes from operating any of the machines of the shop.

12. Prohibit more than one operator from using the hazardous machine at one time.

13. Provide and require the use of point-of-operation guards for operations involving machine cutting, drilling, shaping, planing, boring and forming.

14. Maintain an awareness of the effective use of safeguards against the special hazards associated with the shop instruction.

15. Use painted lines on the floor around each hazardous item of equipment.

16. Place a warning sign on equipment that is unsafe to operate.

17. Prohibit conversations between machine operators and other students while using hazardous machines.

18. Fasten all machines securely to the floor.

19. Post safety rules at or near each hazardous machine or danger area.

20. Use standardized color coding on hazardous machines to emphasize danger areas.

21. Fasten all benches securely to the floor.

22. Accept personal responsibility for all students using machines or hand tools in the shop.

23. Disconnect the main power line when the teacher leaves the shop for any period of time.

Housekeeping Practices

1. Provide for the daily removal of all sawdust, shavings, metal cuttings, and other waste material.

2. Provide a toeboard and railing around all balconies used for overhead storage of supplies, equipment, or shop projects.

3. Provide properly marked boxes or bins for various kinds of scrap stock.

4. Employ a standard procedure to keep floors free of oil, water, and foreign material.

5. Provide brushes for the cleaning of equipment after each use.

6. Provide for the sweeping of the shop floors at least once each day depending on the rate of scrap accumulation.

Electrical Safety

1. Make all equipment control switches easily accessible to the operator.

2. Provide a ground on all motors, fuse boxes, switch boxes, and other electrical equipment.

3. Teach students to assume that all electrical apparatus is "hot" and must be treated as such.

4. Provide overload protection on all motors.

5. Provide sub-master switches for disconnecting power-driven machines at convenient locations throughout the shop.

6. Provide fluorescent lights for the general lighting of the shop.

7. Provide individual cut-off switches for each machine – separate from operator control switch.

8. Prohibit use of temporary wiring of any kind in the shop area.

9. Provide individual lights at each machine.

Fire Safety

1. Provide fire extinguishers in the shop area.

2. Store flammable liquids in approved safety containers.

3. Provide for the inspection and testing of fire extinguishers at regular intervals to ascertain if they are fully charged and in proper working condition.

4. Provide instruction in the location and proper use of fire extinguishers and other fire-fighting equipment.

5. Provide instruction in the prevention of fires in the school shop.

6. Provide periodic instruction and practice in the proper procedure for evacuating the shop in case of fire or other emergency situations.

7. Provide for the bulk storage of flammable materials in an area removed from the main school building.

8. Mark the location of fire-fighting equipment in the shop with a large bright red square, arrow, or bar high enough to be visible from any part of the shop.

9. Inspect paint and chemical cabinets periodically, noting the date of inspection on or in the cabinet inspected.

10. Provide, in an easily accessible location in the shop, a large flame-proof blanket for use in the case that someone's clothes ignite.

11. Post instructions for evacuating the school shop in a conspicuous place where they can be seen and read.

12. Prohibit use of flammable liquids for cleaning purposes.

13. Inspect fire extinguishers and other fire fighting equipment at least once each week.

First Aid Practices

1. Provide a first aid kit in the shop.

2. Mark the location of the kit with a green cross large enough to be visible from any point in the shop area.

3. Inspect first aid cabinet periodically to determine condition and amount of supplies.

4. Post the policy of the school regarding the administration of first aid in a conspicuous place in the shop.

5. Enroll in and successfully complete American Red Cross first aid courses.

6. Provide only emergency first aid treatment for serious injuries and then refer to qualified medical personnel for treatment.

Personal Protection

1. Prohibit running in the shop at any time.

2. Prohibit horseplay or practical jokes of any kind within the shop area.

3. Require the wearing of appropriate safety goggles or glasses during any type of grinding operating.

4. Require students to observe prescribed rules in regard to proper clothing and protective devices when operating hazardous equipment.

5. Require the wearing of goggles with appropriate lens when danger from radiation or glare exists.

6. Stress the importance of shop sanitation.

7. Require the wearing of safety goggles or glasses when there is a danger of flying particles or chips.

8. Provide respirators for student use where harmful dusts or fumes exist.

9. Require the supplemental use of face shields during the hazardous operations in cutting metal, wood, or other similar materials.

10. Determine the physical defects and limitations of all students so that they will not be assigned tasks detrimental to their health or physical condition.

11. Provide "school purchased" safety goggles or glasses for student use.

12. Prohibit the wearing of four-in-hand ties in the shop.

13. Prohibit the students from wearing rings and other jewelry while working in the shop.

14. When such protective devices are furnished by the school, require sterilization of safety goggles or glasses before reissue.

15. Emphasize the importance of wearing coveralls as proper shop clothing.

General Practices

1. Make an analysis of all hazards in the shop involving machines, hand tools, and general environment.

2. Make regular written reports to the principal or director regarding any hazardous conditions in the shop.

3. Provide a non-skid floor surface in the operating area of all hazardous machines.

4. Use alternating yellow and black stripes on protruding parts, low beams, and tripping hazards.

5. Have the ventilation system in the shop checked at the beginning of each school year by a trained and experienced ventilation engineer to determine effectiveness.

6. Provide aisles at least four feet wide throughout the shop for general travel.

7. Use a bell, whistle, or some other type of alarm to command the attention of every student in the shop during emergency situations.

8. Require students to sign an acknowledgment of safety instruction and safety pledge.

9. Carry liability insurance as a protection against possible negligence charges brought by parents of injured students.

10. Encourage all students to carry accident insurance while enrolled in shop courses.

11. Require visitors to get approval from the director or principal before entering the shop.

SAFETY STANDARDS

Codes, standards, and rules must be considered by teachers as important factors in the development of an accident prevention program. As the future workers of business and industry, shop and laboratory students should be thoroughly aware of safety standards. They should be acquainted with the codes and regulations pertaining to machine guarding, industrial housekeeping, fire protection, dust removal, handling materials, personal protection, etc. Standards of safety have a direct bearing on the development of safe work habits and attitudes, and when individuals do not act in accordance with safety standards, accidents are liable to occur. Russell DeReamer[1] emphasized this point when he said: "Workers use the five primary senses, sight, smell, taste, touch, and hearing to perceive objects, signals, and changes in the work environment. Each perception is relayed through the nervous system to the brain, where the information is noted and evaluated. In making the evaluation, the worker is guided by past training and experience. When the perception is consistent with the worker's previous experience, a correct evaluation is made in a second. On the other hand, a new situation and in particular one which is inconsistent with previous established patterns may confuse the worker or at least slow up his reaction time." The consistent use of safety standards permits workers and students to rely on their past experiences and habits to contend with work hazards with a higher degree of safety.

Safety standards may be used by teachers to draw comparisons and make evaluations. The use of standards as a basis for evaluating shop elements, processes, and work practices is essential for the development of an effective accident prevention program. Such standards may be classified in two general categories: 1) regulatory standards, and 2) self-applied standards.

The following safety rules apply specifically to arc welding:

1. Perform arc welding only in a screened or enclosed force-ventilated area.

2. Be sure that screens, curtains, or other protective devices have been set up or drawn tight so that the arc flash can be seen only by students wearing a protective shield.

3. Wear an arc welding helmet with proper lens, treated gauntlet gloves, and treated leather apron as protection against ultra-violet and infra-red rays, flames, and hot metal.

4. Make certain that the shield has no openings.

5. Do not permit anyone in the welding booth unless he is wearing an arc welding helmet.

6. Wear a protective leather welding jacket and apron or heavy old clothing.

7. Keep sleeves and pants cuffs rolled down and collar buttoned up.

8. Be sure that the tops of shoes are covered.

9. Protect face and eyes with goggles or a flip-front helmet when clipping slag from welds.

10. Report to the teacher at once if the electrode holder, holder cable connections, cable or cable terminals at the welding machine, ground clamp, plugs, or cable become hot.

11. Secure electrical contacts and grounds to prevent fire or burns.

12. Shut off the welder when welding is completed as a protection against sustained short circuits.

13. When work is completed, suspend the electrode in a manner that will prevent it from touching any metal which could cause it to ground.

14. Keep cable from contacting hot metal.

15. Keep electrode stubs off the floor. They could easily cause a slip or fall.

16. Avoid inhaling of fumes while welding galvanized steel, phosphor bronze, and stainless steel.

HAZARD ANALYSIS

The National Safety Council enumerates the basic measures for preventing accident injury, in the order of effectiveness and preference, as follows:[2]

1. Eliminate the hazard from the machine, method, material, or plant structure.

2. Control the hazard by enclosing or guarding it at its source.

3. Train personnel to be aware of the hazard and to follow safe job procedures to avoid it.

4. Prescribe personal protective equipment to shield personnel against the hazard.

Reference is made in each of these measures to the "hazard." Hazard analysis or identifying the hazard is therefore necessary before any of the four measures can be employed to reduce exposure to accidental injury.

Hazard analysis, referred to in industry as "job safety analysis" or JSA, is a procedure to make a job safe by "1) identifying the hazards or potential accidents associated with each step of the job, and 2) developing a solution for each hazard that will either eliminate or control the exposure."[3] The school shop or laboratory teacher can profitably make an analysis of each job project, exercise, or experiment into its component operations and steps to reveal 1) the existence of physical hazards such as tools, machines, materials, etc., 2) hazardous positions, or actions of students, 3) the necessary qualifications for the performance of the "job," such as physical fitness, special abilities, etc., 4) the safety equipment and devices needed for accident prevention, and 5) the safety standards, including rules and regulations, required for the protection of the students.

The four basic steps for making a job safety analysis as recommended by the National Safety Council[4] are:

1. Select the job to be analyzed.

2. Break the job down into successive steps.

3. Identify the hazards and potential accidents.

4. Develop ways to eliminate the hazards to prevent the potential accidents.

Selecting the Job

A job is a single piece of work done as a part of an occupation. A job is made up of a sequence of separate steps or operations which together accomplishes a definite work goal. In school shops and laboratories, a job may be a project, an exercise, an experiment. Some jobs can be broadly defined in general terms, such as building a house, rebuilding an automobile engine or installing a power line. Jobs defined so broadly, however, are not suitable for job safety analysis. Similarly, a job can be narrowly defined in terms of a single operation, such as driving a nail, tightening a cylinder head bolt, or installing insulator pins on a cross arm. Jobs so narrowly defined are not suitable for job safety analysis. Jobs suitable for a JSA are those job assignments such as a shop or laboratory teacher might make. Stacking building lumber, reboring engine cylinders, or setting power poles on new construction are good subjects for job safety analysis. They are neither too broad nor too narrow. In selecting jobs to be analyzed for hazards or potential accident sources, the teacher should be guided by the following factors:

1. **The frequency of the accidents that the job has produced in the past.** The greater the number of accidents associated with the job, the greater the need for JSA.

2. **The severity of the injuries that the job has produced in the past.** All jobs that have a history of disabling injuries should be given a JSA.

3. **The injury-severity potential of the job.** Some jobs may not have history of disabling injuries, yet they may have the potential for disabling or serious injuries. These jobs are candidates for JSA.

4. **The recentness of the job.** Newly established jobs created by changes in equipment, processes, or the program of instruction will not have history of accidents, but may have accident potential not recognized by the teaching staff. Such jobs need an immediate JSA.

Breaking the Job Down

Before beginning the search for hazards and potential accidents, the teacher must break the job down into a sequence of steps or operations. In the field of vocational education this is known as "job analysis" and is a necessary procedure for determining course content. The steps should describe what is being done and should be listed in the order of occurrence. Details should be omitted. The following rules may be employed in determining the style to be used and preparing the descriptive statements:

1. A terse, direct style should be used.

2. Each statement should begin with a functional verb.

3. The present tense should be used throughout.

4. All words that do not impart necessary information should be omitted.

Here is an example of a step-by-step breakdown of a job in the occupation of power lineman – "setting poles in new construction":

1. Raise pole with derrick on line truck.

2. Use cant hooks to control turning of pole.

3. Lower pole butt into pole hole.

4. Turn pole with cant hooks for proper alignment.

5. Support pole with pike poles at right angles.

6. Plumb pole with a plumb line.

7. Back-fill hole with earth.

8. Tamp earth around hole.

9. Remove pike poles and winch line.

The teacher can turn to several sources for information to assist him in making an analysis of a job. Chief among these are:

1. A personal background of work experience in the job.

2. Observation of others who are working at the job.

3. Consultation with individuals who have had considerable experience in doing the job.

4. A study of other job analyses.

5. A study of trade books.

6. A study of trade periodicals.

7. A study of manufacturers' manuals and handbooks.

There are two common errors made in breaking a job down into its basic operations. One is to make the breakdown too detailed, resulting in an unnecessarily large number of job steps, many of which may not be basic. The other common error is to make the job breakdown too general, resulting in the omission of important steps.

Identifying the Hazards and Potential Accidents

The third step in making a job safety analysis is the analysis of each of the job steps for purposes of identifying hazards and potential accidents. The goal is to determine the presence of **all** real and potential hazards and whether they result from the environment or the job procedure. The teacher should look for specific types of possible accidents. For each step in the job he should answer the following questions:

1. Can the students strike against, be struck by, or otherwise make an injurious contact with, an object?
2. Can the student be caught in, on, or between objects?
3. Can the student slip or trip? Can he fall on the same level or from one level to another?
4. Can the student strain himself by pushing, pulling, or lifting?
5. Does the environment present a potentially hazardous exposure to gases, vapors, mists, fumes, dusts, heat, cold, radiation, noise, or to hazardous substances which are flammable, toxic, corrosive, (to living tissue), irritating, strongly sensitizing, radioactive, or which may generate pressure through heat, decomposition, or other means?

If the answer to any of the above questions is "yes," the analyst should record the specific hazard which might result in accidents. Two kinds of information are needed: the type of accident and the agent involved. The type of accident could be recorded in an abbreviated form such as:

1. SB – struck by
2. CBy – contacted by
3. SA – struck against
4. CW – contact with
5. CBe – caught between
6. CO – caught on
7. CI – caught in
8. FB – fall-to-below
9. FS – fall-same-level
10. O – overexertion
11. E – exposure

Developing Solutions

The final step in job safety analysis is to discover ways and means to eliminate hazards and prevent occurrence of the potential accidents. For each of the recorded hazards the teacher should ask himself the question: How should the student perform the job-step to avoid the potential accident, or what should he do or not do to avoid the accident? Possible answers should then be recorded for each step in the job sequence. Principal solutions include the following:[5]

1. Find an entirely different way to do the job.
2. Change the physical conditions that create the hazards.
3. If changing the physical conditions does not eliminate all the hazards, revise the job procedure.
4. Reduce the frequency of the job by correcting the conditions that make it necessary.

Recording the Job Safety Analysis

A job safety analysis can be recorded several ways. A printed form similar to the one shown in Appendix G could be used. This is an industrial-type work sheet but could be modified for school use. The teacher could design his own recording device. One method would employ 8-½" x 11" paper divided into three equally spaced columns along the 11" side of the paper. In the left-hand column the basic steps of the job are listed in the order which they occur. The center column contains the descriptions of the hazard or potential accidents associated with each job-step. The right-hand column includes the recommended safe job procedure, again associated with each of the hazards or potential hazards listed in the center column.

Another method employs three color-coded 5" x 8" cards: a white card lists the job steps; a pink card lists the associated hazards; a green card lists the possible solutions. The cards, of course, are identified with the name or code number of the job. The reverse side of the card can be used for jobs requiring lengthy descriptions. These cards are then filed systematically, with the "action" or solution cards easily identifiable in safety green to remind the teacher that "here are steps which I must take to insure the safety of my students and myself."

Benefits and Uses of Job Safety Analysis

The major advantages of a hazards analysis come after the task is completed. However, there are many benefits derived from the analysis procedure itself. While making a JSA teachers learn more about the jobs they assign to their students. When students participate in job safety analysis, their attitudes are improved and their knowledge of accident prevention is increased.

The teacher benefits primarily from JSA in the discharge of the following responsibilities:

1. Giving individual instruction to students.
2. Making student safety contacts.
3. Orienting new students to the shop or laboratory situation.
4. Preparing for planned safety observations.
5. Giving pre-job instructions on infrequent or irregularly scheduled jobs.
6. Reviewing job procedure after accidents occur.
7. Studying jobs for possible improvement of technique and procedures.

SAFE USE OF INSTRUCTIONAL EQUIPMENT AND MATERIALS

The safe actions of students can insure the effectiveness of an accident prevention program in school shops and laboratories. Safe action implies acting safely under all circumstances, performing routine tasks in a safe manner, anticipating and overcoming physical hazards and unsafe acts of individuals in new and unfamiliar circumstances. The Metropolitan Life Insurance Company says that "education to prepare such people includes four aspects: **habits**, **skills**, **knowledge**, and **attitudes**."[6] **Habits** of safe living are learned at the same time that students learn other shop and laboratory skills; **skills** of accident prevention are perfected along with the development of manual skills; **knowledge** of an occupation equips a student to combat its hazards, and **knowledge** of accident patterns makes them aware of potential dangers; favorable **attitudes** are derived from the concern and enthusiasm for accident prevention displayed by school administrators, supervisors, faculty, and student leaders, from a great variety of learning experiences, and from the positive rather than the negative approach toward accident prevention.

School administrators, supervisors, and teachers have clear-cut responsibilities for the success of accident prevention. In particular, the teacher should never allow his responsibilities to be abrogated by any administrative delays. Likewise, the student has responsibilities to his teachers, his fellow students, and to himself which are manifested through the safe use of instructional equipment and instruction materials. There are many such responsibilities or practices. Among these student practices are the following (It must be noted, of course, that safe practices of students are also safe practices of teachers):

1. Keep all hand-tools sharp, clean, and in safe working order.
2. Report any defective tools, machines, or other equipment to the teacher.
3. Retain all guards and safety devices except with the specific authorization of the teachers.
4. Operate a hazardous machine only after all other students are clear of the machine.
5. Operate a hazardous machine only after receiving instruction on how to operate the machine safely.
6. Confine long hair before operating rotating equipment.
7. Wear appropriate eye protection wherever there is any danger from flying or falling particles or chips, radiation, glare, or hazardous substances in the work or environment.
8. Wear approved respirator protection where harmful dusts or fumes exist.

9. Wear shop clothing appropriate to the instructional activity being performed.

10. Remove ties when working around machine tools or rotating equipment.

11. Remove rings and other jewelry when working in the shop.

12. Participate in no horseplay, practical jokes, or running in the shop or laboratory area.

13. Report all accidents to the teacher regardless of nature or severity.

14. Turn off the power before leaving a machine tool.

15. Make sure that all guards and barriers are in place and adjusted properly before starting a machine tool.

16. Recognize the distinctive sound of a properly adjusted and smooth-running machine tool.

17. Develop a respect for machine tools and understand their purpose.

18. Use soap and water frequently as a method of preventing skin diseases.

19. Operate an internal combustion engine only if the exhaust is connected properly to an approved ventilation system.

20. Disconnect the power from machine tools before performing the maintenance tasks of oiling or cleaning.

21. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it.

22. Put tools, repair parts, or other objects in their proper place when not in use.

23. Protect the cord of a portable electric hand tool from oil, hot or rough surfaces, and chemicals.

24. Clean the chips from a machine with a brush – not with a rag or the bare hands.

25. Wear suitable gloves or hand pads when handling sharp, heavy, rough, or hot materials and chemicals.

26. Use metal containers for oily waste or oily rags.

27. Operate a machine tool only after being sure that the footing is good.

28. Keep the shop or laboratory floor clear of scraps and litter and wipe up immediately any liquids spilled on the floor.

29. Give undivided attention when operating a machine tool to the task being performed.

30. Avoid using wrenches which do not properly fit the nuts, bolts, or other objects which they are being used to turn.

Facility Design and Layout

Although the individual school administrator, supervisor, or teacher rarely has the opportunity of participating in the design or layout of a new school shop or laboratory facility, there is no reason for ignoring this important problem. Changing course content, rising enrollments, new materials, developing processes, and equipment additions require that existing facilities be under constant scrutiny and modifications be made as needed. Although there seems to be no information available concerning the relationship between accident frequency and school shop or laboratory design and layout, there does seem to be general agreement among educators that the manner in which such facilities are planned can have a direct bearing on accident prevention. The planning elements which should be considered are 1) space allocation, 2) lighting, 3) ventilation, 4) personal service facilities, 5) selection of machine tools and hand tools, 6) placement of equipment, 7) special hazards, 8) traffic flow, and 9) safe access.

Space Allocation

Total space requirements for school shops and laboratories are generally expressed in terms of square feet per student. Recommendations vary with the nature of the activity and the grade level at which it is being taught, from a high of 100 to 150 square feet per student in senior high school auto mechanics classes down to 50 to 100 square feet per student in junior high school drawing classes. This approach is a convenient point of departure for planning, but in order to insure maximum safety for students, each school shop or laboratory must be analyzed with the view of providing adequate space for the specific items of equipment and special hazards in each shop.

As a general rule, all machines, benches, and laboratory equipment should be surrounded by a minimum of three feet of open space. However, certain machines such as cut-off saws, shears, jointers, planers, drill presses, and lathes may need considerably more space to accommodate the long materials which are ordinarily processed with these machines. Major aisles should have a minimum width of four feet, while the allowance for secondary passageways should be three feet. Sufficient open floor space to prevent crowding and interference among students must be provided around all doorways, in project assembly areas, demonstration areas, around the tool crib or tool panels, and near material storage areas. Overhead obstructions such as pipes, duct work, and cranes should have a minimum of seven feet clearance between the lowest part and the floor level. Machines that are more than four feet in height should be placed toward the outside of the layout in order that visibility in the shop will not be obstructed.

Lighting

The problem of natural and artifical lighting for school shops and laboratories is one which involves the school architect and lighting engineer during the planning and building phases of school plant construction. The school shop planner is rarely involved either as an advisor or a consultant in such a highly technical undertaking. He is, however, involved in determining lighting equipment needs for local and special illumination requirements. These include: 1) adjustable lamps for illuminating the point of operation on hazardous machines; 2) portable lamps to provide temporary illumination for projects requiring supplemental lighting; 3) flexible lamps for fine precision bench and machine work, and 4) specialized supplemental lamps for fine and extra-fine inspection processes.

Ventilation

It is generally agreed that ventilation is of great importance in the environment of individuals. It is known that certain diseases are air-borne and that air contaminated by dust, gas, fumes, smoke, vapors, or oders can cause discomfort, sickness, and death. An even more insidious effect of improper ventilation in school shops and laboratories may be the loss of alertness on the part of students which causes them to commit unsafe acts. There is a definite relationship between proper ventilation, comfort level, and the frequency of accident occurrence.

School shop personnel must be concerned both with general room ventilation and special local exhaust ventilation. The subject of ventilation can be quite complex, and the technical considerations involved usually require the services of a heating and ventilating engineer to assure that proper methods and controls are used. However, the effectiveness of original installation is sometimes changed because of building alterations or additions and the introduction of processes or equipment not considered in the initial planning. Also efficient systems sometimes malfunction and school administrators, teachers, and students should be constantly aware of the conditions and changes in the atmospheric environment.

General ventilation is accomplished by introducing fresh outdoor air into school shops and laboratories at the rate of 15 to 30 feet per minute. Although in some cases outside windows are adequate, general ventilation is commonly accomplished by blowers or exhaust systems. Air movement should not be more than 25 lineal feet per minute during the heating season and 100 lineal feet per minute during warm weather.

Special local ventilation is accomplished through individual exhaust systems installed where work activities are carried on which ordinarily result in contamination of the air. The type of local system chosen will vary with the conditions, but in general, permanent work stations require permanent installations, while portable or flexible systems are useful when portable equipment is involved. Some of the school shop activities which require special ventilation are welding, foundry, forging, heat treating, machining cast iron, machine woodworking, auto mechanics, machining of plastics, grinding, electroplating, anodizing, etching, painting, spraying, making blueprints, and machining activities using cutting oil for coolant. Chemical laboratories usually require specially designed exhaust hoods.

Personal Service Facilities

Good personal service facilities within school shop or laboratory areas can do much to maintain student health. A sanitary drinking fountain should be installed at a convenient location. If cooled by mechanical means, the temperature of the water should not be lower than 45° F. but below 60° F. In hot weather it is advisable to provide containers of salt tablets at the fountains. At least one wash basin, two feet of trough, or a circular or semicircular wash fountain with hot and cold running water, preferably from a combination supply fixture, should be provided within the work area for every twenty students. The proper type of soap in an adequate dispenser is important not only for ordinary hygiene but as a protection against dermatitis. Individually dispensed paste, liquid, or powder – not bar soap – should be provided for common use. Paper towels in covered dispensers with a closed disposal receptacle should be located close to the washing facility. In chemical laboratories where hazardous substances are handled, deluge showers, and emergency eye wash fountains should be provided in the immediate vicinity of the hazard.

Lockers in the shop room should be perforated and large enough to permit clothing to be hung up to dry. Lockers should have sloped tops to prevent material from being stored on the tops, and they should be firmly fastened to the floor to prevent overturning.

Selection of Machine Tools and Hand Tools

In general the safest machine is the best machine available to do the job. A safety check list for use in selecting machine tools might well include the following points:

1. Is the machine designed so that it is impossible for the student to be exposed to the point-of-operating or any other hazard point while the machine is operating?
2. Is the machine designed so that, wherever possible, all corners are rounded and no sharp corners or edges are exposed?
3. Are the machine controls located so that the student will not be near the point-of-operation while operating the controls?
4. Are the controls placed so that the student will not have to reach excessively or be off-balance to operate the machine?
5. Are the power transmission and drive mechanism built in as integral parts of the machine?
6. Are overload devices built into the machine?
7. Is the machine designed for mechanical rather than manual holding devices?
8. Are all electrical components of the machine grounded?

Because of highly competitive marketing, manufacturers of machine tools find it advantageous to list safety devices designed for the protection of operators as auxiliary equipment. It is important that school shop personnel be familiar with such items and convince the school business office of the importance of their inclusion in the original purchase order. If adequate guarding is not provided on machinery by the manufacturer as standard equipment, this does not relieve the school of its responsibility for proper guarding.

Attention must also be given to the quality of materials and construction of the many hand tools purchased for the school shop. The quality-built tool is the safe tool, and quality must not be sacrificed for the sake of the budget. Electric hand tools must be equipped with ground wires, and all connections, plugs, terminals, and wires should be checked before acceptance to see that all are of approved construction.

Placement of Equipment

Previous mention has already been made of providing adequate space around equipment. However, care must be taken to locate equipment in such a way that there is no interference between the operations and the operators. Machines should be placed at a 45° angle to window walls in order to secure the maximum effect from natural light. The angular placement also places operators out of alignment with the revolving spindles of machines adjacent to them and thereby reduces the danger from accessories or materials which may be thrown from neighboring equipment.

The maximum size of materials to be worked in a machine should be determined, since additional space may be needed. A lathe to be used for machining long bars fed through the head stock obviously needs more space to the left of the machine than one which is to be used only for chuck work. Certain machines, such as the metal working planer and shaper, need to be placed so that sufficient clear space remains when tables or rams are operating at their maximum distances. All heavy equipment should be leveled and securely fastened to floors. The placement of felt, cork, rubber, or other shock-absorbing material under machines is recommended in order to reduce the noise level. Certain machines, such as cutoff saws and shears, should be placed near the material storage areas in order to reduce hazards from handling large pieces of stock.

Methods used in placement of equipment usually involve scaled drawings of floor plans indicating fixed obstructions such as supporting pillars in walls, window and door openings, and relationship of the room to other service areas. Showing the relative location of all equipment and facilities on a drawing is know as the "single dimension method." The "two-dimensional method" is probably most frequently used and involves arranging on the floor plan drawing flat patterns made to scale and in the shape of the floor area required for each item of equipment. A more revealing technique is to make use of three-dimensional scale models of equipment set up on a drawn-to-scale floor plan. Some equipment manufacturers furnish models upon request, and other models may be carved from soft wood, or made from cardboard. The planner should make several alternative layouts before deciding which will be implemented. It may be found that the introduction of a single item of equipment will demand the rearrangement of the entire floor plan, but additional equipment or a change in emphasis or procedure will require adjustment of the layout without jeopardizing the safety considerations already in effect.

Special Hazards

In almost every shop there are certain pieces of equipment, kinds of materials, or specific processes that deserve extra attention for the protection of students. In many instances, special shielding of certain equipment and isolation of hazardous processes are required. Welding areas must be isolated for the protection of students from flash, burns, and fumes. Foundry and heat-treating areas should be located so as to avoid injury to students. Hand chipping of metal and machining operations that result in flying chips require isolation or special shielding. Areas such as electroplating and etching where acids and chemicals are used need precautionary treatment. Paint and spray areas demand an efficient exhaust ventilation system, as well as an isolated location. An exhaust system is also needed wherever auto or other engines are running. The relatively high speeds of portable and stationary grinding machines and the possibility of wheel breakage require the segregation of these machines from others in the shop.

Special mention should be made of the care needed in handling compressed air and gases. It is especially desirable that oxygen and gas welding tanks are stored outside the school building. Other hazards that should be noted involve the handling and storage of toxic, flammable, or volatile materials such as gasoline, kerosene, naptha, and various oils, paints, varnish. These require special precautions in their storage and use. Compatible storage of reactive chemicals must also be taken into consideration.

Individual electric power control should be standardized on all equipment and located for the convenience of the operator. A central master control is of great importance. It should be conspicuously marked, have provision for locking, and be readily accessible to the instructor. All electrical equipment should be grounded.

It is probable that many school shops and laboratories may soon be faced with the special hazards of ionizing radiation. Many precautions need to be taken when and if radioactive materials or radiation-producing devices are introduced to the school. It is a fairly safe assumption, of course, that the layout of shops will require revision.

Traffic Flow

Because of the nature of school shop and laboratory work, there is necessarily some student movement within the area. Certain areas are commonly visited by students one or more times during a class period. Provisions should be made for traffic between the work stations and these areas without the danger of exposure to hazards or interference with the work of others. Examples of such areas include: tool cribs, tool panels, planning and study areas, material storage areas, lockers, drinking fountain, wash-up areas, teaching center, and general equipment such as tool grinders and drill presses. Well marked aisles help to accommodate travel to and from these areas and keep congestion at a minimum.

Safe Access

Failure to provide safe access to every point in a school shop or laboratory is responsible for many serious accidents. In order to realize the importance of such a provision, the "safety" planner, for example, should accompany the "maintenance or repair student" often enough to keep informed of the potential hazards which he faces in his assigned work. Failure to provide safe access affects the safety of individuals doing such work as window cleaning and building repairs, overhauling and repairing of overhead electrical equipment, and work on equipment located in out-of-the-way places.

MANUAL HANDLING AND STORAGE OF MATERIALS AND TOOLS

Although the problems involved in the manual handling of materials and the storage of materials and tools are somewhat related in terms of accident prevention in school shops and laboratories, they will be treated separately in this section of this publication.

Manual Handling

Accidents in manual handling of materials by students are primarily the result of unsafe working habits – improper lifting, carrying too heavy a load, incorrect gripping, and failing to wear personal protective equipment. Training in safe work habits, breakdown and study of job operations by the teacher, and adequate supervision can help to minimize these accidents.

Lifting

"It's not what you lift but how you lift it." This statement applies to the lifting, lowering, or moving of heavy equipment or loads. Periodic demonstrations should be given by the teacher in "how to lift a heavy object" using the following procedure prescribed by the National Safety Council;[7] the reverse procedure is followed for lowering the load.

1. First make a preliminary 'heft' to be sure that the load is easily within your lifting capacity. If it is not, secure help.
2. Set your feet solidly and well apart, one foot slightly ahead of the other. In some cases, it might be easier to go down almost to the floor on one knee while keeping the other leg at a 90° angle.
3. Crouch as close to the load as possible with legs bent at about a 90° angle at the knee.
4. Keep the back as straight as possible, it should not be arched.
5. Get a firm grip on the object, lifting one end slightly if necessary to get one hand under it. Grip the load so that it will not slip while you are lifting and carrying it and so that your hand will be protected.
6. To lift the object, straighten your legs, keeping your back erect and your head up.

Team Lifting and Carrying

When two or more students must carry a single heavy object, they should be similar in size and physique. One acting as a leader should position himself so that he can watch and coach the others. He should use predetermined signals to control the lifting, carrying, and setting down of the object. All students should act together so that no extra burden will be placed suddenly upon one student.

When two students carry long sections of pipe or lumber, they should carry on the same shoulder and walk in step. Shoulder pads will prevent cutting of the shoulders and help to reduce fatigue.

Storage of Materials and Tools

The safe storage of materials and tools is directly related to effective teaching and instruction, good housekeeping activities, fire prevention procedures, and other elements of a safe school shop environment. Inadequate or unsafe storage procedures and practices frequently create hazardous environmental conditions dangerous to students working in the shop and create fire or explosion hazards that might damage the building. Lack of storage facilities invites unsatisfactory housekeeping practices and increases the difficulty of handling materials, tools and projects, thereby increasing the accident-producing hazards in the shop.

Safe storage facilities for materials and tools are provided in school shops for several reasons. The primary purpose is to protect students and other persons working in the shop from accidents. Adequate storage facilities are also needed to protect tools and materials from theft, unauthorized use, improper or unsafe handling, breakage, and deterioration. Lack of adequate storage areas for tools and materials creates many unsafe conditions which cause accidents. Unsafe acts may be committed by shop students because of insufficient storage space. Efficient storage practices will enable the teacher to keep an accurate up-to-date inventory of materials and supplies in the shop.

Many storage problems could have been eliminated in the planning stages of the building or school shop. However, storage arrangements frequently are completely omitted from the original layouts of shops, or if included, such space as is provided is inadequate, inflexible, and arranged with little allowance for growth or expansion of the shop facilities. No one storage method or procedure is best for all shops or conditions, but from the standpoint of efficiency and safety the shop or laboratory teacher can follow certain general considerations in arranging for the safe storage of shop tools and materials.

Location of Storage Facilities

The general location of storage rooms may depend upon the size of the shop or laboratory, the nature of the activities, class enrollments, and nature of the materials and tools. Generally, storage rooms should be located adjacent to the work area and close to places where the student will need materials. Supply storage areas should be located in or near the shop, so that the students have easy access to materials without having to cross the paths or traffic patterns of other students. Safety and ease of storage, delivery of supplies, and the issuing of materials should be considered when planning the location of storage facilities. It is desirable to have an outside door or unloading ramp near the storage room. Storage areas should be arranged and located to reduce traffic and eliminate congestion during the class period. Crowded areas are prolific accident producers. Tool panels and cabinets should be located away from hazardous machinery. Supplies of flammable liquids should be stored in an area apart from the main building. The storage facility for flammable liquids and other materials should be located so that the sun's rays and other sources of heat do not reach them. Chemicals which may react with one another if spilled should be stored separately in compatible groups.

Construction Considerations

Shelves, racks, bins, and cabinets should be designed and constructed to hold the maximum number of tools and items safely without the danger of collapsing. Storage racks constructed with steel or pipe are usually safer than those built of wood and create fewer fire hazards. Extra-strength racks may be needed for large portable tools and other heavy items. Racks should be designed so that heavy items are stored on the bottom shelves.

Storage Methods

All materials, tools, parts, and accessories should be stored safely and neatly and arranged in an orderly and accessible way in the places provided, regardless of the specific storage method. Those items used most frequently should be stored within easy reach on the lower shelves. Storage areas must be clean, orderly, ventilated, and well-lighted. Containers, bins, shelves, and drawers which contain caustics, liquids, acid solvents, and bundles of materials should be clearly labeled. Supplies and materials should never be stored on the tops of lockers or cabinets, because there is always the danger of objects falling from these places. Generally, vertical storage of long pieces of material creates greater hazards than horizontal methods of storage.

Tool Storage

Many different methods and techniques have been devised for storing hand and portable tools. The most common tool storage methods are tool panels, centralized tool cribs, wall cabinets, bench drawers, and movable racks. Regardless of the methods selected by the teacher, tool storage facilities should be designed and arranged to provide maximum protection to students and shop workers. Many accidents have been caused by tools falling from overhead, by knives and other sharp tools being carried in pockets, and by chisels laid loosely in tool boxes.

Materials Storage

The average shop contains hundreds of different hardware items and supplies. Each presents a different storage problem. Regardless of the system used, the storage facilities should be well located for convenience and safety. Many shop teachers use the closed storage method, in which all supplies and materials are kept locked in the storeroom or cabinets. Other teachers use the open storage methods, where students are permitted to use supplies as they are needed. A combination of the open and closed systems of materials storage is used by most teachers. For safety reasons, some materials, particularly hazardous chemicals, should be kept under lock and key and used only under the immediate supervision of the teacher.

Flammable Liquids and Finishing Supplies

The storage of flammable liquids, such as gasoline, thinners, benzene, and other liquids, presents many problems from the standpoints of convenience, fire control and prevention, health of students, and explosions. The storage of such materials can be very troublesome and dangerous unless flammable liquid storage areas are carefully planned and provisions made to safely care for the various types of flammable materials.

MACHINE GUARDING

Machine guarding protects against injury to individuals from the following sources:

1. Direct contact with the moving parts of a machine.
2. Work in process; i.e., kickbacks on circular saws, metal chips from machine tools, splashing of hot metal or chemicals, etc.
3. Mechanical failure.
4. Electrical failure.
5. Human failure, resulting from curiosity, zeal, distraction, fatigue, indolence, worry, anger, illness, deliberate chance taking, etc.

This section of the Guide will be limited to a discussion of the first three sources. They are commonly classified as "mechanical hazards." Mechanical hazards may be further classified into two general categories: 1) power transmission hazards, and 2) point-of-operation hazards.

Power Transmission Hazards

Power transmission apparatus includes shafting, belts, pulleys, couplings, keys, collars, set screws, gears, and prime movers. The motions and actions which result in hazardous exposures in the transmission of mechanical power are classified as 1) rotating motions, 2) reciprocating motions, 3) transverse motions, and 4) in-running nip points.

Rotating Motion

A rotating shaft is a good example of rotating motion. It may be smooth or rough, it may rotate slowly or rapidly; it may be of small or large diameter. Regardless of its characteristics, it is hazardous when it is revolving. Shafting which appears to be smooth can grip clothing and cause serious injury. A revolving shaft may be vertical or horizontal – a lead screw on a lathe or the spindle of a drill press. The hazard increases if pulleys are mounted on the shaft or if collars, couplings, or projecting keys are installed.

Reciprocating Motion

This motion is best described as the back and forth motion of a ram, such as might be found on a metal-working shaper or the bed of a surface grinder. There are two points of danger: 1) The point where the moving part approaches or crosses the fixed member, and 2) the point of the pinch. This pinch point would be found at the end of the back motion of a ram, where an individual could be crushed between the moving part and a wall or column.

Transverse Motion

This motion is produced by a transmission belt which passes over a pulley and has its direction changes 180°. In doing so, nip points are created where the belt and the pulley come in contact. The motion is quite common to large power transmission belts and pulleys as well as to belt sanders.

In-running Nip Points

This hazard is created whenever machine parts rotate towards each other or where one machine part rotates towards a stationary object. Objects or parts of the body may be drawn into this type of nip point and be severely bruised or crushed. The in-running side of rolling mills, rolls used for bending, printing, corrugating, embossing, feeding and conveying of stock, the in-running side of a chain and sprocket, a gear rack, and a gear and pinion are examples of in-running nip point hazards.

Point-of-Operations Hazards

Point of operation hazards are present at the cutting point of a machine and are created by the processes of sawing, drilling, grinding, turning, printing, planing, sanding, forming, punching, shearing, and shaping. Each machine used in school shops to perform these processes offers a unique accident prevention problem at the operating point. The following are some examples of these machines:

Circular Saw

This machine is designed to permit a wide variety of operations including cross-cutting, ripping, and dadoing of wood stock. There are two principal types of accidents connected with its operations: 1) contact with the rotating blade by the operator, and 2) kickback of material striking the operation.

Jointer and Planer

Both of these machines, used extensively in school shops, utilize knives mounted on steel shafts and rotating at high speed to provide a planing or surfacing action on wood stock. The jointer is the more hazardous of the two machines since the knives are easily uncovered, exposing the operator to blade contact. Planer knives are relatively well shielded during the machine's construction, making the operator less vulnerable to contact with the rotating knives.

Band Saw

Injuries from this machine are usually less severe than those of the circular saw, jointer, or planer. The feeding of wood stock, however, is usually accomplished free hand, bringing the operator's hands very close to the fast-moving saw blade.

Shaper

This can be an extremely hazardous machine which requires careful use by the student under the close supervision of the teacher. The nature and location of the cutting knives, the very high operating speeds, and the small size of the wood stock often used make the machine very difficult to guard.

Portable Power Saw

All portable power tools can be considered as special types of hand tools, powered by air or electricity, which introduce certain special hazards to the shop student. The portable circular power saw, however, offers the greatest point-of-operation hazard, since the teeth of the blade must be exposed during the woodcutting operation.

Metalworking Machine Tools

Machine tools used to perform metalworking operations are difficult to guard at the point of operation and offer many extreme hazards. Injuries from these machines include those caused by students coming in contact with moving cutters, rams, dies, or stock, and by flying chips.

Other Metalworking Machines

Such machines may range from small bench machines to the large pressing, stamping, and forging machine. Their power may range from foot and hand operation to electric and hydraulic power. Regardless of the nature of the driving power, all machines involving moving parts need guards against hazards at the point of operation.

Types of Guards

Three types of guards are common to both power transmission guarding and point-of-operation guarding: 1) fixed, 2) interlocking, and 3) automatic. A manufactured or a home-made guard may be purchased or constructed with one or several of these characteristics.

Fixed Guards

A fixed guard is one which is secured in a permanent stationary position around the dangerous parts. The fixed guard is preferable to all other types of guards and should be used in every case unless it is definitely impracticable. Its advantage is that it prevents access to the danger points of the machine by completely enclosing the hazardous operation at all times. It also serves in many cases to prevent bursting parts from flying about. Specific power transmission parts commonly guarded by enclosure guards or fixed guards include horizontal shafting, belts, and pulleys, couplings, shaft ends, and sheaves. These guards are commonly used in connection with barriers for guarding large pulleys and inclined belts.

Interlocking Guards

Interlocking guards are considered the first substitute for the fixed guard. They may be actuated mechanically, electrically, pneumatically, or by a combination of these means, and they prevent operation of the machine until the guard is moved into position. These guards are designed so that if the machine is in operation and the guard is opened or the barrier is crossed or dropped, the machine will come to an immediate stop. The machine cannot be started unless the guard is in its proper position. An effective interlocking guard must satisfy the following three requirements: 1) it must guard the hazardous part before the machine can be operated; 2) it must stay closed until the hazardous part is at rest; and 3) it must prevent operation of the machine if the locking devise fails.

Automatic Guards

An automatic guard is one that operates independently of the operator and repeats its actions as long as the machine is in operation. Only after the operator's hands, arms, and body are removed from the danger zone can the machine operate.

Summary of Guard Requirements

The following points should be considered as requirements for acceptable machine guards:

1. They must conform to the standards of the United States of America Standards Institute and the State Inspection Department having jurisdiction over the school shop.
2. They must be considered by the instructor and student as a permanent part of the machine or equipment.
3. They must be designed and constructed to afford maximum positive protection to all people working on or around the machine.
4. They must prevent access to the danger zone while the machine is in operation.
5. They must not weaken the structure of the machine.
6. They must not interfere with the efficient operation of the machine or cause discomfort to the operator.
7. They must be designed for the specific job and the specific machine, with provisions being made for oiling, inspecting, adjusting, and repairing of the machine.
8. They must be durable, resistent to fire, wear, and corrosion, and easily repairable without sacrificing the effectiveness of the guard.
9. They must be strong enough to resist normal wear and shock and to withstand long usage with minimum maintenance.
10. They should not in themselves present hazards such as splinters, pinch points, shear points, sharp corners, rough edges, or other sources of injury.
11. Whenever possible, guards should be interlocked so that the machine will not operate unless the guard is giving maximum protection.
12. They should be painted to conform with the ASA color code recommendations.

The student who works around mechanical equipment or serves as an operator of a piece of machinery must develop and maintain a respect for safeguards.

No deviation from the following safe work practices should be tolerated:

1. No guard should be adjusted or removed for any reason by anyone unless a) specific permission is given by the teacher, b) the person concerned is specifically trained, and c) machine adjustment is considered a normal part of the student's task.

2. No machine should be started unless the guards are in place and in good condition. Defective or missing guards should be reported to the teacher immediately.

3. Whenever safeguards or devices are removed to repair, adjust, or service the equipment (lubrication and maintenance), the power for the equipment should be turned off and the main switch locked and tagged.

4. Students should not be permitted to work on or around mechanical equipment while wearing neck ties, loose clothing, watches, rings, or other jewelry.

School administrators and shop teachers should avail themselves of the excellent publications dealing with subject of machine guarding. These publications are the United States of America Standards Institute's *American Standard Safety Code for Mechanical Power Transmission Apparatus* and *The Principles and Techniques of Mechanical Guarding*, Bulletin No. 197 of the Bureau of Labor Standards, U.S. Department of Labor.

MAINTENANCE FOR SAFETY

Maintenance is an important aspect of accident prevention in school shops and laboratories which is often overlooked. In addition to assuring maximum operation of equipment and facilities at a minimum cost, proper maintenance will provide the safest possible working conditions for students and instructors. Unsafe conditions are at times due to insufficient or improper maintenance and result in accidents causing injuries to students, costly property damage, or both. Instances in which poor maintenance can lead to accidental injury or damage to equipment are numerous. The following are typical examples:

1. Floor maintenance. Roughness, slipperiness from wear, holes, splinters, and poor patching contribute heavily to the sources of injuries that are numerically most important – namely, handling, slipping, tripping, and falling. Such defects also often contribute to "machinery" injuries.

2. The condition of all portable equipment that students climb or stand on or work from, is important from a safety standpoint. These include portable ladders, steps, saw horses, scaffold, planks, etc.

3. Defective tools are prolific sources of injury. This applies not only to familiar hand tools such as chisels and wrenches, but also because of their increased use, to power hand tools such as grinders and drills.

4. Unless properly maintained, machine guards and safety devices not only fail to protect but also give a false sense of security which may be worse than no protection at all.

5. A higher standard of maintenance than is necessary for educational purposes may be vital to safety. For instance, clutch wear may cause unexpected starting of a machine.

6. Electric wiring becomes unsafe not only from use but from temporary repairs, alterations, or additions. "Temporary" jobs tend to become permanent unless carefully limited to necessities and immediately made standard when the emergency has passed.

7. Windows, lights, and reflectors may become dirty, and light bulbs may be burned out.

8. The ventilation for the shop or laboratory may not be properly adjusted, with screen filters not replaced or the ventilator overloaded.

Maintenance can operate in two ways: 1) routine repetitive maintenance necessary on a day-by-day basis to keep equipment clean and operating, and 2) preventive maintenance which involves overhaul of equipment in one degree or another or on a predetermined schedule before breakdown occurs.[3] These two approaches to maintenance differ only in the way they operate, and some overlapping is usually involved. In fact, both types of maintenance may be carried out to a degree by student personnel.

Routine Maintenance

Routine maintenance is required primarily to keep equipment and the working area in the same operating condition without a major change. Routine maintenance is for the purpose of maintaining the status quo rather than detecting and correcting conditions which may cause future trouble. If the conditions are good, maintenance keeps them that way; if conditions are not good, routine maintenance will not improve them. When a condition is uncovered which points to future breakdown, it should be routinely repaired, but all too often repairs are made only after the breakdown occurs. Routine maintenance involves a variety of things – oiling of machinery, disposal of scrap, inspecting condition of tools, a general clean-up, minor repairs of machines and equipment due to a breakdown, and similar activities.

The fact that maintenance is routine in nature does not detract from its importance, either in maintaining a training program or preventing injuries. It is an important activity, and a maintenance program will materially assist creating an efficient safe-working environment. But a good maintenance program should be planned and organized in the same way as any other activity. In planning and organizing, consideration should be given to at least these five steps:

1. Develop effective maintenance procedures to cover all maintenance activities.

2. Formulate schedules to cover repetitive operations, such as lubrication of machines, cleaning windows and lighting fixtures, and disposal of scrap.

3. Establish a procedure for handling non-repetitive jobs, such as repairs and installation of machines.

4. Arrange to have frequently needed spare parts on hand for equipment repair.

5. Develop a follow-up system to assure that procedures and schedules are followed.

The importance of routine maintenance should not be underestimated. When properly planned and organized, it can be a definite factor in controlling accidents in school shops and laboratories.

Preventive Maintenance

Preventive maintenance has a different purpose than routine maintenance. It aims to prevent conditions from arising which could result in costly delays due to the breakdown of equipment. Such conditions can be detected through inspection and prevented by periodic overhaul or replacement. A good illustration of preventive maintenance fundamentals is found in commercial airline operations. Close inspection of the aircraft is made after every trip. A more detailed inspection is made after a fixed number of hours, and a complete overhaul is given at the end of a specified number of flying hours. Extensive records are kept on the findings of such inspections, and the repairs or replacements are made on the basis of the needs indicated by the inspection. Many items are corrected upon report to the pilot, and most of them before malfunctions or failure occur. The inspection or overhaul provides a sound basis for scheduling work to avoid rush handling of emergency jobs involving excessive overtime.

Preventive maintenance may be defined as an orderly, uniform, continuous, and scheduled procedure to prevent breakdown and prolong the useful life of equipment and buildings. Some advantages to be gained from preventive maintenance include the following.

1. Decrease of "downtime" of equipment due to breakdown.

2. Reduced repair costs.

3. Increase in the life of the equipment.

4. More training time on the equipment available.

5. A safer working condition for students.

In determining whether a system of preventive maintenance is worthwhile, the following questions need to be considered:

1. Does the cost in inspection exceed the cost of repair and value of downtime?

2. Will the normal life of the equipment exceed the need without preventive maintenance?

3. Does the good condition of the equipment contribute to safe working conditions for the students?

4. Is the equipment critical to the training process?

5. Is standby equipment available for continuation of the training process in the case of failure?

If the answer to questions 1, 2, or 5 is yes, the need for preventive maintenance is doubtful. If the answer to 3 or 4 is yes, the need is at once apparent. Under most conditions, preventive maintenance is necessary to maintain training facilities, and it is almost always necessary to eliminate dangerous conditions involving mechanical equipment.

Successful preventive maintenance in school shops and laboratories involves at least the following factors:

1. Regular systematic inspections of all machines, equipment, and premises.

2. A program of periodic replacement of essential equipment or parts.

3. Keeping records of inspections, replacements, and findings.

4. Repairs and replacements made as indicated from inspections or in accordance with replacement schedules.

5. Follow-through to evaluate the progress.

A preventive maintenance program, rather than a simple repair system, will result in considerable savings in training economies. It will also lessen the number of accidents. Many school injuries are charged to training hazards, but the true cause may often be poor maintenance; proper maintenance would have eliminated the hazard and consequently would have prevented the resulting accident. Unsafe conditions which lead to accidents frequently stem directly from failure to spot a threatened breakdown before it occurs. But preventive maintenance does more than reduce injuries due to accidents. It promotes orderly and economic training; it controls equipment losses; and it helps improve training methods generally. Good maintenance also promotes proper utilization of tools, equipment, and machines. Adequate tool storage with inspection and dispensing procedures assures issuance of the right tool for the job, one properly dressed or sharpened, and in overall satisfactory condition. When safe and properly maintained tools are issued to students, they have an added incentive to give the tools better care. Preventive maintenance is a conservation program at the training level, a systematic method of saving which will return dividends in training and in accident prevention.

FIRE PREVENTION AND EXTINGUISHMENT

School administrators, supervisors, and teachers must be concerned with fire protection for students under their care. The combination of fire and explosion has resulted in the greatest of school disasters in terms of human and material loss. Those responsible for planning and operating school facilities should seek advice from their local fire department, fire insurance carrier, fire inspection bureau, Underwriters Laboratories, National Safety Council, and appropriate state officials in order to assess the adequacy of their fire protection and control methods.

Understanding Fire

Four conditions must be present simultaneously in order for a fire to start and burn:

1. Oxygen must be present – air usually contains between 16 to 21% of oxygen, with the average flame starting to extinguish below 16% oxygen. In some cases, the oxygen is incorporated directly into a chemical and air is not necessary for burning to occur.

2. There must be a supply of fuel – any combustible material such as wood, paper, oils, etc.

3. The temperature of the fuel must be above the ignition point; ignition temperatures vary; wood – 469 to 514° F.; newsprint paper – 451° F.; pyroxylin plastic – 275° F.; and cotton (duck) – 439° F.

4. A flame chain reaction exists – fuel molecules appear to combine with oxygen in a series of successive intermediate stages, called branched-chain reactions, in arriving at the final end products of combustion. These intermediate stages are responsible for the evolution of flames.

To prevent or stop active fire, one of the four conditions listed above must be eliminated.

Four fundamental requirements must be operative in an adequate fire prevention, protection, and control program in school shops and laboratories. These are to a) prevent the outbreak of fire, b) prevent the spread of fire, c) provide prompt detection and extinguishment of fire, and d) provide suitable exits and prevent panic.

Cause of Fire[9]

"Because the nature of school shop work requires the use of fire, heat and flammable or combustible materials, there are numerous sources from which flame may originate. The general shop, where several different processes and materials are in use, is probably more vulnerable to fire hazards than the unit shop. Attention should be called to the following factors when planning for fire prevention:

Gas

"Gas is used extensively in school shops as the fuel for brazing, heat treating, soldering, and melting furnaces. Gas equipment may leak or gas may escape because of faulty ignition in the appliance. Frequent inspection and the use of safety pilots and cut-off valves is essential where gas is in use. Special instruction must be given to students before they are permitted to light gas-fired torches or appliances.

Housekeeping

"Housekeeping is inseparable from fire protection. Flammable and combustible materials need to be stored in the proper place and manner. Rubbish must not be allowed to accumulate on floors, in corners, or other niches. Waste material should be removed daily. Oil accumulation on floors or oil-soaked wood or porous floors may ignite if contacted by flame, sparks, or sufficient heat.

Electrical equipment

"Electrical devices and equipment which are improperly installed, worn, old, or poorly maintained may precipitate a fire. Short circuits causing arcing and heating sufficient to ignite flammable materials, an accumulation of oil or grease around motors, and the breakdown of insulation around old wiring are common causes of short circuits. Other causes may be found in the use of improper wire size, fuses too large for wire capacity, extension cords improperly used or maintained, and poor connections in the wiring.

Matches and Smoking

"Common causes of fire in industrial plants which should be controlled in the school situation are matches and smoking. Smoking should be no problem in most school shops, since students are usually not allowed this privilege. However, it is known that custodians, teachers, and visitors sometimes smoke in shops during "off" hours. Of course, this should be prohibited. Matches present a different problem because they are used and carried by students. Only safety matches should be allowed in the shop, and whenever torches are to be lit, the safety, flint, or scratch type lighter should always be used.

Spontaneous Ignition

"This form of ignition perhaps has been more common in school shops than in industry, due partially to lack of understanding by students and to the fact that combustibles are often left in one location for considerable lengths of time; i.e., over weekends and holidays. Oily or paint-soaked rags and clothing left in student lockers are probably the greatest hazard. Other sources contributing to this hazard are rubbish and accumulation of dust, lint, and oil in duct work and flues. Safety metal containers with a self-closing lid must be used for the storage of oily or paint-filled waste and rags.

Open Flames

"This is an obvious hazard which accompanies the performance of welding, soldering, forging, forming, and other heating operations. Fireproof materials such as steel plates and asbestos sheets should be installed around permanent equipment. The greatest hazards are present when portable equipment such as gas welders, blow torches, bunsen burners, plumber's furnaces, and soldering torches are in use. Students must be given thorough instruction in the operation and care of such equipment. Open flames should not be left unattended. The immediate area where they are to be used should be cleared of flammable or combustible material, and the operator must use care in directing the flame in order to prevent burns to himself, others and adjacent material. Appropriate clothing should be worn in these types of operations.

Heated Surfaces

"Heated surfaces are found on furnaces, flues, glue pots, hot plates, hot metals, and regular or infra-red light bulbs. These heated surfaces will cause fires if flammable or combustible materials are close enough to absorb heat sufficient to raise it to the ignition point. Building codes prescribe the minimum clearance between such surfaces and adjacent combustible materials. Surrounding areas should be kept clear of flammable material, and walls, bench tops, and ceilings near such surfaces should be covered with nonflammable materials. Occasionally a heated surface will develop from friction caused by slipping belts, hot bearings, or moving parts rubbing against guards, floors, or other stationary objects. The presence of oil, grease, or rubbish near these areas may result in a fire.

Molten Metal

"Hot, molten metal from welding and foundry operations must be controlled through use of proper handling equipment in areas constructed from fireproof material. Nonflammable personal protective clothing is required for students working in these areas. The danger from flying globules of molten metal or of spilling molten metals is ever present with these operations, and if molten metals come into contact with flammable material, ignition will result.

Volatile Liquids

"Such liquids include paint, varnish, lacquer, sealers, finishing materials, cleaners, solvents and other petroleum products. They are frequent sources of fires, caused by vapors resulting from the rapid evaporation of the liquids. The liquid itself does not burn, but heat causes vaporization which may be ignited by sparks from nearby heated metals, sparks from metallic objects striking together, electrical spark from light switches, static electricity, or any open flame. Vapors are generally heavier than air and may travel along the floor a considerable distance before they are ignited and flash back to the sources. Tight metal containers, properly color coded, labeled, and kept in metal cabinets, are a requirement for storage. Fire prevention codes specify that no more than five gallons of such liquids may be stored inside the work area. Approved metal safety cans having an antiflash screen or flame arrester in the spout should be used."

Classification of Fires[10]

"Four general classifications of fires based on the types of extinguishing media necessary to combat each have been adopted by the National Fire Protection Association.

Class A Fires

"Class A fires are those which occur in ordinary materials, such as wood, paper excelsior, rags, and rubbish. The quenching and cooling effects of water or of solutions containing large percentages of water are of first importance in extinguishing these fires. Special dry chemical agents (multi-purpose dry chemical) provide rapid knockdown of the flames and the formation of a coating which tends to retard further combustion.

Class B Fires

"Class B fires are those which occur in the vapor-air mixture over the surface of flammable liquids such as gasoline, oil, grease, paints, and thinners. The limiting of air (oxygen), or the combustion-inhibiting effect, is of primary importance on fires of this class. Solid streams of water are likely to spread the fire. Under certain circumstances water fog nozzles prove effective. Generally, regular dry chemical, multi-purpose dry chemical, or carbon dioxide foam are used, depending on the circumstances of the fire.

Class C Fires

"Fires that occur in or near electrical equipment where non-conducting extinguishing agents must be used are called Class C Fires. Dry chemical, carbon dioxide, or compressed gas extinguishing agents are suitable. Foam or a stream of water are good conductors and can expose the operator to a severe shock hazard and therefore should not be used. Water from a very fine spray can sometimes be used on fires and electrical equipment, as in transformers. A spray is not as good an electrical conductor as a stream of water is, therefore safer to use in such cases.

Class D Fires

"Fires that occur in combustible metals such as magnesium titanium, zirconium, lithium, and sodium are classified under Class D. Specialized techniques, extinguishing agents, and extinguishing equipment have been developed to control and extinguish fires of this type. Normal extinguishing agents generally should not be used on metal fires, as there is a danger in most cases of increasing the intensity of the fire due to chemical reactions between extinguishing agents and the burning metal."

Control of Fires[11]

"Most schools have an alarm system for signaling students and teachers that the building should be evacuated because of fire, gas, smoke, or impending disaster, and most states require by law that schools hold fire drills at regular intervals. Shop teachers must make certain that they know the fire drill regulations and instruct students in procedures to follow. The general school fire drill signal should be in a location and of a type that can be easily heard by students working in noisy shops. The location of the nearest switch or box used for signaling fires should be known to shop teachers and students in case they need to report shop fires. The location of fire exits should be conspicuously marked and known by all.

"In addition to knowing exactly what to do during a general fire drill, shop students need to be told what should be done before they evacuate the building. When the alarm is sounded:

1. Students should stop activity and listen for instructions.
2. Each piece of operating equipment should be turned off and all power disconnected at the main switch.
3. Gas valves, torches, and portable heating equipment should be turned off.
4. Students should leave the area immediately and according to the fire drill plan.

"Effective fire control within the school shop involves a system for evacuating the room independent of the rest of the school in cases where the fire originates in a shop area. Perhaps more important in the day-to-day operation of shops are the fire prevention measures and the protection incorporated in the organization of the shop. However, even with the best of facilities fire may occur, and proper fire fighting equipment must be at hand and ready to use. Portable fire extinguishers of the types suitable for controlling Class A, B, or C fires must be prominently and conveniently located about the rooom. Each type should be located close to an area where the corresponding type fires are apt to occur. The soda acid, or water type is commonly used for Class A fires. For Class B and C Fires, as well as small Class A Fires, the dry chemical, and carbon dioxide extinguishers may be used. Recently, manufacturers of fire protection equipment have developed an all-purpose extinguisher reported to be effective against all classes of fires. The liquid and the vaporizing type of extinguisher using carbon tetrachloride are no longer recommended because of the generation of extremely toxic fumes when applied to a fire.

"Fire extinguishers must be inspected frequently and recharged periodically. The local fire department will usually give advice, assistance, and maintenance, as well as instruction in the use of fire fighting equipment. Students should receive instruction on the care and use of the different types of fire extinguishers. An efficient fire protection plan will include the use of students as fire fighters, since quick control of small fires is essential to the prevention of major fires. If the building is properly planned and equipment is properly installed, if correct materials are used and students are properly taught, the chances of disaster from fire will be greatly diminished."

ELECTRICAL HAZARDS[12]

"Almost everyone living in our industrialized society is familiar with the countless uses of electricity as a source of heat and power. In fact, the use of electricity has become so commonplace that few people realize the potential dangers of electrical energy. Many men, women, and children die each year from electrical shock and burns. Most of these tragedies could have been prevented had the necessary precautions been taken to eliminate unsafe electrical conditions and practices. School shop and laboratory teachers must recognize the importance of and need for the identification and elimination of hazards created by electricity.

"Failure to understand the danger of electrical energy is a cause of many accidents. Electrical energy is not to be feared, but to be respected. The teacher should understand the relationships between amperage, voltage, and resistance. The use of the terms 'low-voltage' and 'high-voltage' has led many persons to erroneously believe that low voltage is relatively safe and that there if very little danger of shock from the average home or shop electrical circuit. Such is not the case, since 'low voltage' is usually considered by most authorities to be any voltage less than 550 volts. Fatal accidents have been caused by contact with electrical circuits containing less than 50 volts, and deaths have been caused by circuits carrying 1/10 ampere or less. The school shop teacher must assume that any electrical circuit is a potential hazard, regardless of the amount of voltage or amperage flowing through the wires to the equipment.

Results of Electrical Accidents

"Numerous factors affect the results of electrical accidents. Bodily contact with the hazards of electricity may result in producing 1) nerve shock, 2) severe burns, 3) fire damage, and 4) physical injuries. The severity of injuries from electricity depends upon a wide variety of factors.

"Shock occurs when an electrical current flows through any part of the body. Electricity is a 'live' force which is always seeking a path to the ground in order to complete the circuit. When the human body becomes a part of the circuit, there may be electrical shock. The severity of the shock may be very slight, ranging from a mere tingling sensation, to a very severe shock causing muscle contraction of certain vital organs in the body. The severity of the shock will depend upon 1) the rate of flow of current through the body measured in amperes, 2) the path of the current through the body, and 3) the length of time the body is in the circuit. Other factors which may affect the degree of shock are the frequency of the current, phase of the heart cycle when shock occurs, and the physical and psychological condition of the person.

"The amount of current which flows through the body will depend upon skin and clothing resistance, the insulating qualities of the surrounding area, the amount of voltage in the circuit; and the manner of contact with the live circuit. Dry human skin does offer some resistance to the flow of electricity, although this resistance varies with other special conditions. It has been estimated that dry skin offers from 100,000 to 600,000 ohms of resistance, while wet and sweaty skin will offer a resistance of only 1,000 ohms or less to the flow of electricity. Assuming the body offers only 1,000 ohms of resistance, the 110 volts would push sufficient amperage through the body to result in a serious injury or fatality.

"The path the current takes as it flows through the body will depend upon the nature of the contact with the energized circuit. If the head area is in contact with electric current and the feet are grounded, the current will very likely pass through the brain, lungs, and heart, causing muscular spasms resulting in death. However, if one foot touches a live wire while the other foot is on the ground, the current is not likely to pass through one of the vital organs of the body and the injury will probably be less severe.

"The length of time a victim of electric shock is in contact with an energized circuit is very relevant to the degree of injury. Sometimes a victim is knocked away from the circuit immediately after touching the charged object and little or no damage occurs, whereas a longer contact with a live circuit may cause some of the organs of the body to stop functioning.

"The nature of the injury may be affected by the frequency of the current and the kind of electrical energy. Direct current is usually considered less hazardous than alternating current as far as shock is concerned, but is more likely to produce severe burns and tissue damage. The physical condition of the victim is another factor which has a bearing on the severity of electrical shock.

"Electric shock affects the human body in various ways, depending upon the presence of the various factors mentioned above. It may cause a temporary paralysis of the nerves that control breathing and thus breathing will stop. It may cause the chest muscles to contract and result in asphyxiation, or it may cause the heart muscles to contract and interfere with the normal rhythm of the heart, thus stopping circulation of the blood. In addition to nerve shock, severe burns may result from contact with an energized circuit, especially a high voltage direct current. Contact with a live circuit may destroy the tissue and nerves of the body. Wounds caused by arcing electrical current are usually severe and slow healing.

"Other accidents, injuries, and property loss may result from fires caused by unsafe electrical conditions or practices. In fact, most injuries caused by electrical hazards are secondary effects, such as falls due to shock, accidental starting of motors, circuit breaker handles hitting various parts of the body, etc. Numerous fires resulting in injury are caused by poor electrical maintenance, unsafe installation procedures, improper use of equipment, or overloading of circuits.

Causes of Electrical Accidents

"Electrical accidents are caused by unsafe conditions, unsafe practices, or a combination of both. Statistics tabulated by state labor departments reveal that several hundred industrial workers are killed and possibly 5,000 persons injured each year by accidental contact with electricity. A study in the State of California by the Division of Labor Statistics and Research reveals that 'unsafe practices were reported in four out of five accidents. Using unsafe or defective tools or equipment led the list, while failure to de-energize equipment, using tools or equipment in an unsafe manner, and working in hazardous places, were next in that order.' Causes of electrical accidents can in most cases be traced to 1) defective equipment, 2) unsafe work practices, and 3) lack of knowledge of the dangers of electricity.

Defective Equipment

"Types of equipment involved in electrical accidents include motor-driven equipment, control devices, portable electric tools, switches, panels, cutouts, conductors, plugs and fuses, and electric extension cords. A variety of unsafe conditions involving the different types of equipment creates many electrical hazards. Some of the common defects of tools and equipment are listed as follows:

1. Improperly grounded equipment (ground wires missing, broken, or improperly connected).
2. Open conduits, switch boxes, damaged or worn connections, and exposed live wires.
3. Insulation which is defective, inadequate, worn, frayed, wet, oily or deteriorated creating short circuit possibilities, and energizing equipment frames.
4. Defective switches, receptacles, extension cords, and lamp sockets.
5. Dirty motor windings, improperly adjusted brushes, and inadequate maintenance procedures and upkeep of electrical equipment and accessories.
6. Improperly connected power tools and defective insulation in portable tools.
7. Loose vibrating machine parts which might create short circuits and energized machine frames.

Unsafe Practices

"Unsafe practices and work procedures result in electrical accidents and fires. Some of the common unsafe acts committed in the shop are:

1. Using ungrounded equipment and portable tools or removing ground connections.
2. Using defective tools or equipment in need of repair.
3. Using equipment which does not meet the approval of the Underwriters Laboratories or other similar agencies.
4. Unsafe cleaning of electrical panels, switch boxes, motors, and other electrical equipment with water or dangerous solvents.
5. Overloading of circuits or overfusing circuits by the use of wrong size or type of fuse.
6. Failure to use explosion-proof or vapor-proof fixtures in dangerous areas.
7. Failure to use suitable safety equipment, gloves, rubber mats, etc., for electrical installation and repair.
8. Failure to de-energize circuits before working on equipment.
9. Failure to properly mark, tag, or identify and lock switches prior to working on electrical equipment.

10. Installation of electrical facilities not meeting the National Electrical Code.

11. Improper opening and closing of switches and improper use of electrical equipment.

12. Permitting rubbish, trash, rags, etc., to accumulate near electrical equipment.

13. Work practices which damage motors, insulation, wires, or electrical accessories.

14. Disconnecting of electric cords by pulling on the cords rather than on the plug; stringing extension cords around the shop.

15. Use of metal ladders while working on electrical equipment.

"Although the above list of unsafe practices is far from complete, the shop teacher should be aware of the common electrical hazards and unsafe practices and be able to identify and eliminate them.

Lack of Knowledge

"Ignorance is no excuse as the cause of electrical accidents. It is unfortunate that a number of electrical accidents do happen because the person 'just didn't know any better.' Too many people lack an understanding of electricity which could be remedied through adequate supervision and a sound educational program.

Prevention and Elimination of Electrical Hazards

"Electrical hazards may be controlled by a program directed toward 1) preventing the development of hazards, and 2) eliminating present hazards. In both cases a positive program of action must include education and training. Students should be taught the basic concepts necessary to understand electrical energy. Safe practices should be taught and the reasons for following definite procedures explained to the students. Teachers should analyze the shop environment and list all possible sources of electrical hazards. Each item on the list should be discussed with students and the safe practices which attend each hazard should be taught to all concerned. When students fully understand the causes and results of electrical accidents, they will want to assist the instructor in identifying present hazards and potentially dangerous situations.

"Identification of existing and potential electrical hazards requires frequent and systematic inspection of all equipment. Each teacher should develop a check list of items pertinent to his area of responsibility. Student inspection can be a part of the regular duties of the 'safety engineer' and through a personnel system, students can be taught to make visual inspections. A most important corollary in an inspection program is the development of student awareness of electrical safety. Visual inspection of motors, generators, panels, transformers, controls, switches, lights, outlets, conduits, and cords should be made on a scheduled basis. Attention should be directed toward 1) damaged or broken material - insulation, wire, receptacles, plugs, switches, etc., 2) accumulation of oil, water, dust, or other extraneous matter near equipment, 3) malfunctioning equipment, and 4) warning signs and markings. In addition to visual inspections, circuits and equipment should be ground-tested, using a suitable type of tester such as a low-range ohmmeter, to determine the condition of circuit grounds. Equipment and circuits should also be checked with a megohmeter to determine if current leakage may have developed due to insulation deterioration. If periodic readings are made and recorded, it is possible to anticipate the replacement of wiring or insulation. Likewise, a record of visual inspections presents a picture of the condition of electrical equipment in the shop to the teachers. Once identified, electrical hazards can be readily eliminated. This may involve such actions as rewiring, adding insulation, isolating certain equipment, grounding equipment, replacing parts, or simply cleaning equipment.

"Preventive maintenance practices and regularly scheduled maintenance of electrical equipment must be included in any safety program. Accumulation of dust, grease, or a combination of the two in electrical panels, motors, and generators will eventually lead to electrical troubles and may result in short circuits which can harm students or cause fires. The continued use of worn or improperly lubricated equipment can also cause insulation breakdown. Manufacturer's recommendations for lubricating and cleaning electrical equipment should be followed at all times.

"Some electrical hazards can be prevented at the time equipment is purchased. Only equipment meeting the Underwriters' approval should be considered for use in school shops. There are differences among items of equipment in regard to the degree of control of electrical hazards. The wise shop teacher will select the equipment which offers the most protection to the user. Such things as polarized plugs, heavy insulation, lock-out switches, and safety switches should be considered.

"Even though the safest equipment available is purchased, the value of careful selection is lost if equipment is improperly installed. All wiring and installation should be done by qualified electricians who will perform the work in accordance with the local and state requirements, as well as meeting the specifications of the National Electrical Code. Haphazard electrical work and so-called temporary hookups must not be permitted in the school shop. All original and subsequent electrical installations should be made so that:

1. All equipment is properly grounded.
2. Wiring is of adequate size to carry the intended load.
3. Each item of equipment is individually protected with fuses or circuit breakers.
4. Wiring is protected from damage.
5. Sub-master switches are installed.
6. Magnetic starting switches are incorporated on each piece of equipment to prevent inadvertent restarting.

"In shops where two or more voltages are used for different kinds of portable equipment, special receptacles are needed for each voltage. Receptacles and the corresponding cord plugs must be designed to eliminate all possibility of connecting the equipment to the wrong source of power. Cord plugs should not be adapted in the school shop, and the use of adapters should be strictly forbidden.

"In summary, an adequate program for the prevention and elimination of electrical hazards must rest upon 1) intelligent selection and purchase of equipment, 2) correct installation of equipment, 3) education of students in the safe use of electrical energy, 4) periodic inspection of equipment, and 5) regular maintenance."

HOUSEKEEPING[13]

"Most safety specialists and competent vocational teachers consider housekeeping to be one of the most important activities in creating an environment relatively free from accident-producing hazards. The term 'housekeeping' is often misunderstood and misrepresented by some to mean a 'push broom' activity in the school shop and laboratory area. Housekeeping means more than keeping the facilities clean and free of undesirable scraps, shavings, and dirt. It also means orderliness. Housekeeping includes an orderly arrangement of tools, equipment, operations, storage facilities, and materials. The shop is in order when there are no unnecessary materials, tools, and scraps scattered about the area, and necessary tools and materials are in their proper places. The often quoted phrase 'a place for everything and everything in its place' is most appropriate in a discussion of housekeeping in school shops and laboratories. . ."

Objectives of Housekeeping

"Housekeeping in an accident prevention program has many objectives. Everyone working in the shop or laboratory has a personal responsibility to help the teacher realize the goals of maintaining a clean and orderly work area. Specifically, a few of the goals of effective housekeeping programs are:

1. To reduce or eliminate hazards which cause accidents from falls, slips, striking against objects, and falling objects.
2. To eliminate the hazards from fire through the provision of approved containers, proper storage facilities, and clean-up procedures.
3. To develop an awareness of the need for housekeeping measures in an accident prevention program.
4. To develop the desired attitudes towards safe working conditions and practices and sanitary conditions.
5. To develop an understanding of the essentials of an effective housekeeping program.
6. To familiarize students with the responsibilities of housekeeping and to instill in them the desire for clean and orderly surroundings.

Responsibilities for Housekeeping

"The planning and maintaining of an effective housekeeping program in school shops and laboratories are the combined responsibilities of the administration, the teachers, and the students. In fact, everyone working in these areas must assume some of the responsibility for keeping the facility clean and orderly. Administrators must recognize that good housekeeping procedures are very important in an accident prevention program, and the administration must take the lead in formulating general policies and plans for shop housekeeping. The administration has the specific responsibility to provide adequate space and funds, because effective housekeeping practices are most difficult in a crowded, poorly arranged, and improperly planned shop or laboratory. The teacher has the immediate responsibility for the program, since housekeeping is largely a matter of management and organization. Good housekeeping will depend upon the provision of:

1. Adequate storage rooms, areas, shelves, racks, and cabinets for materials and supplies, projects, tools, equipment, and accessories.
2. Suitable containers for scraps, shavings, chips, and other waste material.
3. Splash guards and oil pans on all machines using oil and coolant.
4. Adequate dust collecting systems.
5. Proper housekeeping instruction and training.
6. Proper layout of equipment, traffic areas, aisles, and working areas.
7. Adequate housekeeping and janitorial facilities for cleaning windows, ledges, shelves, etc.

Good Housekeeping Practices

"Good housekeeping cannot be attained by an occasional grand clean-up. If the shop or laboratory is to be kept clean and orderly, the program must be planned and organized. Teachers should adopt a policy of locating and correcting conditions that produce congestion, disorder, dirt, waste, trash, and other poor housekeeping conditions. The program for keeping the area clean must be one of continuous activity, and procedures must be established for checking and evaluating its effectiveness. Various inspection lists have been developed to check on housekeeping practices, or teachers may want to develop their own inspection check lists adapted to the needs of their particular shop. The National Safety Council inspection list discussed in this Guide provides a reminder of things to look for when checking on clean and orderly conditions. The following are examples of good housekeeping practices:

1. The general appearance of the area is clean, orderly, and well painted, with adequate lighting and ventilating facilities.
2. The machinery and equipment are arranged to permit safe efficient work practices and ease in cleaning.
3. Materials and supplies are safely stacked or stored in proper places.
4. Tools and accessories are safely stored in cabinets, on racks, or other suitable devices.
5. Sufficient waste containers and receptacles are provided in appropriate locations and emptied frequently.
6. The working areas and work benches are clear and free of debris and other hazards.
7. Floors are clean and free from all obstructions, foreign material, or slippery substances such as water, oil, and grease. Floor surfaces are slip resistant.
8. Aisles, traffic areas, and exits are free of materials and other debris. They are properly marked and defined.
9. All corners are clean, well lighted, and free from waste materials.
10. Combustible materials are properly disposed or stored in approved containers.
11. Clean rags and waste are stored in metal containers, while oily rags are stored in self-closing or spring-lid metal containers.
12. All flammable liquids are stored in safety cans and the safety cans are stored in fireproof rooms or cabinets.

13. Dangerous materials are stored in areas outside of the main building.

14. All boxes, bins, shelves, cabinets, or containers used to store materials are properly marked or labeled.

15. Excess materials are not allowed to remain in the work areas.

16. Floors, walls, ceilings, ducts, electric lights, and windows are cleaned frequently and regularly.

17. Obsolete equipment is removed from the shop area and disposed of.

18. Sufficient brooms, brushes, cleaners, and other housekeeping equipment are readily available.

19. Pupil personnel organization systems are used to carry out specific housekeeping duties.

20. Personnel working in the area are instructed on the proper procedures to follow in keeping the area clean and orderly.

21. Regular and systematic inspections are made to maintain clean and orderly conditions."

HEALTH HAZARDS

The variety of substances and processes presenting hazards to the health of students in school shops and laboratories steadily increases. Safeguarding the present and future health of these students is the prime responsibility of school administrators, supervisors, and teachers. The purpose of this section of the Guide is to acquaint school personnel with potential occupational health hazards, types of exposure, and measures commonly used to control these hazards. This information in turn should be transmitted to the students – the future workers and supervisiors of our industries.

Classification of Hazards

Occupational health hazards which may adversely affect a worker or a shop or laboratory student are usually classified as a) chemical agents, b) biological agents, and c) physical agents.

Chemical Agents

Chemical agents in industry and in school shops are liquids, solids, and gases which may produce injury by ingestion, contact or inhalation. The chemical agents of particular concern are those which are flammable, toxic, corrosive (to living tissue), irritating, strongly sensitizing, radioactive, or which generate pressure through heat, decomposition, or other means. These agents may also be dispersed in the air as dusts, fumes, mists, vapors, and gases.

Dusts are solid particles which may be generated by the grinding, drilling, sawing, filing, turning, sanding, shaping, detonation, pounding, or crushing of materials such as rock, metal, wood, ore, coal, grain, glass, and plastics. Dusts can be dispersed in the air but will eventually settle. Thus they do not diffuse in the air. The most hazardous dusts which can be found in school shops are lead and quartz. Lead dusts may result from the sawing of lead type slugs or from the remelter in the printing shop. Lead dusts may also be found in ceramic shops where glazes containing lead oxide are processed. Quartz dusts are present in molding sands and some parting compounds used in the foundry shop. In vocational agriculture shops, organic phosphates can be found in some pesticides used in the instructional process. In some cases wood dusts can be very toxic to sensitive students.

Fumes are solid particles in the air generated by condensation from the gaseous state, generally after volatilization from molten metals. Fumes found in school shops include lead fumes in printing shops generated by type composing machines and from remelt lead pots and from ceramic kilns where lead oxide glazes are fired. Lead, cadmium, zinc, and other metallic fumes can be generated during the welding, brazing, cutting, or soldering of metals.

Mists are liquid droplets suspended in the air and generated by condensation or by splashing, foaming, or atomizing. Acid mists are present in electrical or auto mechanics shops where storage batteries are charged. Oil mists are present in machine shops where machine tool lubricants or coolants are used.

Vapors are liquids or solids in a gaseous state. Vapors diffuse in the air. The major souce of health hazards from vapors are the toxic solvents commonly found in most school shops and laboratories. Among these are trichloroethylene and perchloroethylene (used as degreasers and as solvents in some types of plastic cements or dopes); carbon tetrachloride (solvent for fats and waxes, rubber solvent type cleaner); methylchloroform (solvent for oils, fats, waxes, resins, and rubbers); turpentine (solvent for oil paints); and acetates, ketones, and alcohols generally used as lacquer thinner. Inhalation of solvent vapors can cause serious damage to the kidneys, liver, and other vital organs. Repeated inhalation of the vapor of trichloroethylene, for example, can cause serious injury to the nervous system, the lungs, the skin, and the digestive tract. The vapors of carbon tetrachloride are readily absorbed by the mucous membranes and the lungs; and in chronic exposure, damage to the liver, heart, and kidneys may result. The vapors of turpentine may act as a strong irritant and systemic poison and, when absorbed through the lungs, may cause kidney damage.

Gases are normally elastic fluids which occupy the space of enclosure and which can be changed to a solid or liquid state through the combination of increased pressure and decreased temperature. Gases will diffuse in the air. The most common of the hazardous gases to be found in school shops are carbon monoxide and oxides of nitrogen and ozone. Carbon monoxide may be found in auto mechanics shops, in metal shops, and in industrial arts ceramics areas. Carbon monoxide has no warning properties and may reach a hazardous concentration before students are aware of its presence. Oxides of nitrogen are produced by the action of ultra-violet radiation on the nitrogen of air, as in inert gas shield and arc welding. The shield of argon gas around the arc increases the production of ozone, and the use of a consumable electrode increases it still more. Ozone is a lung-injuring gas and may be lethal with sufficient exposure. The addition of nitrogen oxide to the ozone will increase the toxicity of the ozone.

Biological Agents[14]

"Health hazards associated with occupational exposure to biological agents have not received the same attention in this county as have chemical and physical agents. This is perhaps due to the fact that illness caused by them is symptomatically similar to and usually attributed to nonoccupational causes. Nevertheless, certain bacteria, fungi, and parasites of occupational origin are known to cause illness, extreme discomfort, and even death in some instances. Bacterial infections, for example, may arise in employees of slaughter and meat-packing plants from handling cattle infected with Bang's diseases, and anthrax may develop in employees handling unsterilized wool and hair bristles imported from certain foreign countries. Athlete's foot is a common fungus infection. Though painful and uncomfortable, it is usually not disabling and rarely occupational. On the other hand, histoplasmosis, a condition caused by a fungus which has been isolated from chicken manure and the soil around poultry houses, may cause a serious and prolonged illness. Parasites such as mites cause grain and cheese itch. And while parasites are seldom disabling, they can cause extreme discomfort."

Physical Agents

Exposures to environmental conditions or physical agents are just as important and encompass as large a field from the standpoint of occupational health as do the chemical agents. Physical agents and conditions usually include the following: a) electromagnetic **and ionizing** radiation; b) noise; c) extremes of temperature and humidity; d) abnormal air pressure; and e) repeated motion, shock, or vibration. Exposure to these conditions are significant in industrial operations and are therefore areas of concern to shop and laboratory educators.

Electromagnetic radiation encompasses a wide range of absorbable energy and is perhaps the most important of the physical agents. The portion of the electromagnetic spectrum of physiological concern extends from microwaves to cosmic rays. Of increasing importance to occupational health and safety personnel is the control of ionizing radiation from sources of electro-magnetic energy or radioactive particles. Some of these, x-rays, alpha, beta, and gamma radiation, for example, can be extremely dangerous, even in exposures of short duration. Others, such as ultra-violet, can cause irritating to severe burns following moderate exposures, while others like radio waves cause no apparent injury to the body even after a lifetime of exposure. In addition to radio isotopes, the chief sources of ionizing radiation are various types of electronic equipment found in electrical and electronics shops. Exposure to ultra-violet radiation can result from such sources as the arc welding process, ultra-violet lamps used for inspecting flaws in metal castings, or carbon arcs used in the printing shop for etching plates. Injury from infra-red radiation can result from prolonged exposure to molten metals, heat from heat treating ovens, pottery kilns, and infra-red lamps. Radiant heat passes through the air without heating it, and its effect is not apparent until it strikes an object such as the human body. As technical education expands and provides more shop and laboratory experiences for students, the greater will become the hazards from such devices as radar, microwave generators, and diathermy equipment. Exposure to microwaves can cause serious tissue injury. The extent of the hazard, however, depends upon the wave length, the power density, and the duration of exposure.

Noise in the school shop is not as serious as the other health hazards previously discussed. Increasing attention, however, is being given to occupational exposure to high levels of noise. Noise is generally defined as unwanted sound and chronic exposure at certain levels can cause temporary or permanent loss of hearing, nervousness, and fatigue. The degree of injury depends upon intensity, frequency, duration of exposure, and the susceptibility of the individual.

Extremes of temperature and humidity as environmental conditions should not pose a health problem in school shops and laboratories. Students should be aware, however, that conditions do prevail in certain industrial operations which result in more complaints among workers than all of the other physical agents and conditions combined. A reduction in the quality and quantity of work output, increased fatigue, and a host of other personal complaints may result from extremes of temperature and humidity. If extremes of low temperature are involved, such as subzero food storage lockers and experimental test chambers, workers may develop frostbite. From a practical viewpoint, however, sudden and abrupt changes in temperature and humidity are more important because of the more adverse physiological effects upon workers. There is evidence that exposure to cold and changes in temperature may lower resistance to infection. A number of factors determine the reaction of an individual to adverse temperature and humidity conditions. Among these are a) air temperature, b) relative humidity, c) radiant heat, d) air motion, e) degree of exertion, f) type of clothing, and g) acclimatization.

Abnormal air pressure as an environmental condition should not pose a health problem in school shops and laboratories, but again this potential hazard should be brought to the attention of students. Caisson disease is an illness, occuring among divers, caisson workers, and submarine tunnel workers, caused by the too rapid removal from pressure resulting in the liberation of nitrogen gas bubbles in body tissues and fluids. The gas formed in the tissues blocks the capillaries and cuts off the blood supply to and from various parts of the body. The symptoms, known as the "bends," are pains in the muscles and joints, tingling of the skin, and dizziness, and in severe cases asphyxia may occur.

Repeated motion, vibration, or shock as a category of physical agents is receiving increased attention in the field of occupational health hazards, although this may not be of concern at present in school shops and laboratories. It is believed, however, that vibrating tools and machinery may induce nervousness and fatigue in some individuals, while long and continued use of vibratory tools may cause nerve injury and inflammation of tissue surrounding tendons, bones, and joints. Rock drillers and high speed grinder operators sometimes experience soft tissue, tendon, bone, muscular, and nerve disorders.

Types of Exposures[15]

"Chemical and biological agents enter the body by inhalation, through the skin, or by ingestion. Inhalation and skin contact are important because the majority of occupational diseases results from breathing dusts, fumes, vapors, gases and mists, and from skin contact with chemical or biological materials.

Inhalation

"Frequently, toxic materials are quickly absorbed into the blood or, when inhaled, into the fluids in the lungs. Carbon monixide, for example, combines with the red blood cells 300 times more readily than does oxygen. An individual inhaling one ounce of alcohol as vapor would feel the effects much faster than if he had drunk the same quantity. Most solvent vapors and gases when inhaled in sufficient amounts produce their injurious effects on the human system in a relatively short time. Some dusts and fumes may be partly or wholly dissolved by the fluids in the lungs and then absorbed by the system. Fumes cause injury by irritation of the air passages as well as of lung tissue. Some dusts set up an inflammatory process leading to changes in lung tissue which eventually affect the vital capacity of the lungs.

Skin Contact

"Occupational skin diseases account for a large part of workmen's compensation claims. The increasing use of epoxy resins, for example, cause numerous outbreaks of dermatosis, due primarily to the amine hardeners or catalysts. Chrome ulcers of the skin and contact dermatitis can be caused by chromic acid and its salts. Individual susceptibility to skin disease vary; some persons have a low tolerance while others may develop a high tolerance to these materials. Solvents such as trichloroethylene and mineral spirits dissolve the protective surface lipids from the skin, facilitate the loss of water, and result in dry, chapped, or cracked skin. Fissuring and cracking of the skin make it readily susceptible to secondary infection. Corrosive chemicals such as strong acids and alkalis and certain of their salts attack the skin directly. Contact with high concentration of these chemicals can cause burns, resulting in the destruction of tissue and permanent scars or disfigurement. A few toxic substances such as aniline, tetraethyl lead, and carbon disulfide can be absorbed through the skin and cause systemic poisoning. Chronic effects can also occur from continued absorption of some substances through the skin. (Absorption of hazardous substances may also occur through the mucous membranes of the lips, mouth, nose, and eyes.)

Ingestion

"Chronic poisoning can occur if small amounts of toxic substances are swallowed daily. When dealing with toxic substances such as lead, arsenic, mercury, and the new insecticides, every precaution must be taken to prevent their entry into the digestive tract. Frequent washing of the hands, especially before eating or smoking, will reduce this hazard considerably."

Control of the Environment

Control of exposure to health hazards in the school shop and laboratory situation may be accomplished through one or more of the following methods:

1. **A change of process.** For example, paint may be applied with a brush instead of a spray gun.
2. **Substitution of less toxic materials.** For example, a less toxic solvent may be used as a substitute for carbon tetrachloride.
3. **Control at the point of generation.** Localized exhaust ducts, for example, could be used during the arc welding process.
4. **Enclose the operation.** A screen or shield, for example, could be placed around an arc welding job or permanent cubicles provided for student use in welding operation.
5. **Dilution with uncontaminated air.** This is especially applicable where the exposure is to solvent vapors.
6. **Personal protective devices.** An example would be the use of approved helmets, gloves, and clothing during arc welding activity.
7. **Maintenance, housekeeping, and education.** An example of maintenance is the cleaning of the blades of an exhaust fan in a paint spray booth. The use of vacuum cleaners or vacuum lines in the shop is a good example of housekeeping. Education of the workers and students is important if they are to use effectively the control measures provided for their health and safety.

PERSONAL PROTECTIVE EQUIPMENT

The safety-minded shop or laboratory teacher will recognize the need for eliminating hazards at all possible points of occurrence, and he must therefore be an expert in his own right. The teacher must be alert to dangers of handling materials, hand tools, power equipment, and processes and practices carried on in the shop. He must recognize unsafe machinery and equipment which may have been inadvisably placed in the school shop. The alert teacher will either eliminate such items or take steps to properly guard the devices before they are used by students. Only after this has been accomplished to the teacher's complete satisfaction, should he turn to the need for personal protective equipment. In other words, a machine so designed that it effectively prevents the possibility of flying particles and other such hazards eliminates a cause of accidents at the source. This is a more basic treatment of the problem than the use of personal protective equipment. Goggles, for example, are protective devices, but they do nothing to eliminate or reduce the hazard at its source. Personal protective equipment should never be considered the first line of defense in hazard elimination. Equipment of this nature is only "backup" protection for the unexpected or of the unusual.

Personal protective equipment can conveniently be classifed as follows:

1. Eye and face protection
    a. Goggles
    b. Spectacles
    c. Helmets and hand shields
    d. Face shields
2. Head and ear protection
    a. Hard hats
    b. Hair protection
    c. Ear protection
3. Hand, foot, and leg protection
    a. Gloves and hand leathers
    b. Foot protection
    c. Leg protection
4. Respiratory equipment
    a. Filter respirators
    b. Other respiratory protective devices
5. Protective clothing
    a. Shop coats
    b. Aprons
    c. Coveralls and overalls

Eye and Face Protection

One of the best starting points for establishing the habit of using personal safety equipment is the use of eye protection. Instructors and students alike are well aware of the value of sight and full vision, and proper eye care is emphasized even in childhood. Vivid memories of the pain resulting from the entry of minute foreign particles further reinforce the value of eye care. Shop and laboratory teachers should establish a one hundred percent eye protection program; meaning that every person, including the teacher and visitors, must wear the required eye protective equipment at all times while in the shop or laboratory, rather than on an individual job basis. An increasing number of state legislatures have passed state laws which require one hundred percent eye protection in school shops and laboratories. The National Society for the Prevention of Blindness, Inc. (16 East Fortieth Street, New York, New York, 10016) has made available to state school administrators a model school eye safety law. Further information can be obtained by writing directly to the National Society. An excellent series of articles on eye protecton has been published by the National Safety Council in their *National Safety News.*

Each eye, face, or face and eye protector is designed for a particular hazard. Only protective eye wear of industrial quality as specified by the United States of America Standards Institute, or equal should be used. The USASI quality standards cover such important features of protective eye wear as lens thickness, lens penetration, lens retention, optical quality, flame resistance of the frame, sterilizability, warp resistance and the like. In selecting the protector, consideration should be given to the kind and degree of hazard, and the protector should be selected on that basis. Where there is a choice of protectors, the degree of protection required should govern the selection. Where the degree of protection required is not an important issue, student comfort may be a deciding factor.

A brief description of various types of eye and face protectors, along with suggestions for their use and an understanding of their limitations, follows:

Goggles

Goggles consist of a pair of contour-shaped eyecups or facial contact parts with glass or plastic lenses worn over the eyes and held in place by a headband for the protection of the eyes and the eye sockets. The term "goggles" is also loosely but incorrectly applied to spectacle-type protectors. There are several types of goggles:

1. **Eyecup goggles.** Each eyecup is provided with a lens retainer bearing evenly on the lens with sufficient pressure to retain fragments in the event of lens breakage. The design permits the ready removal or replacement of lenses. Lens retainers for welders and cutters are made to

accommodate a filter lens, fiber gasket, and cover lens.

2. **Flexible-fitting goggles.** Flexible-fitting goggles protect against fine dust, fumes, liquids, splashes, mists, and sprays. The frame is composed of a flexible, chemical-resistent, nontoxic, nonirritating, slow-burning material forming a lens holder. The flexible-fitting goggles are usually ventilated to prevent fogging. In some cases, the ventilation is so designed as to make the goggles splash-proof. Since the frame is of nonrigid material, they offer less protection against impact than do eyecup goggles.

3. **Plastic eyeshield goggles.** Plastic eyeshield goggles provide protection against light flying objects and, when so designed, against glare and injurious radiation. They are acceptable for light chipping or grinding operations, for use around woodworking machines, for spot welding, for babbitting, and for protection against glare or low concentration of injurious radiation. They should not be used for protection against severe flying object hazards or for welding.

4. **Foundrymen's goggles.** Foundrymen's goggles consist of a mask made of flexible, nonirritating, and noncumbustible or slow-burning material, metal lens holders, lenses, and a positive means of support on the face. The edge of the mask in contact with the face is provided with a binding of corduroy or other suitable material. These goggles are used to provide protection against impact and hot metal splash hazards encountered in foundry operations, such as melting, pouring, chipping, babbitting, grinding, and riveting. They are also designated to provide protection against dust.

Spectacles

Safety spectacles are devices patterned after the conventional type street wear spectacles but are of more substantial construction, either with or without side shields, and with impact-resistant lenses. Clip-on side shields are also available for easy conversion of spectacles for frontal protection to protection from the side. Lenses may be clear or filter type, glass or plastic. Corrective safety lenses may also be mounted in spectacles with safety frames provided the lenses are tempered to meet the proper impact standards. Two types of spectacles are described below:

1. **Metal, plastic or combination frame spectacles.** Spectacles are intended to provide protection from flying objects and glare and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side as well as frontal eye protection is necessary, the spectacles should be provided with side shields made of metal or slow-burning plastic materials. Spectacles are used for light chipping operations, for grinding, for machine tool operations, and for other jobs involving flying object hazards. When provided with filter lenses, they may be used for furnace operations, molten metal handling, spot welding, and work adjacent to welding.

2. **Plastic eyeshield spectacles.** Plastic eyeshield spectacles are designed to provide protection to the eye from flying objects and glare and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side as well as frontal protection is required, spectacles are provided with side shields. Plastic eyeshield spectacles are used under the same conditions as plastic or metal frame spectacles, although they are not as durable as the latter.

Students who require vision correction should be encouraged to obtain prescription safety glasses. When students wear prescription spectacles which do not have safety lenses in safety frames, an appropriate cover goggle should be worn over the regular street wear as a protection against shattering of the unhardened lenses. Because of their added cost, prescription safety glasses should be protected against pitting during grinding operations by the wearing of a face shield, cover goggles or light weight sacrificial plastic clip-ons.

Most cover goggle frames are molded in either a flexible or rigid vinyl or soft rubber material. Headbands consist of an elastic adjustable strap which is replaceable at a very nominal cost.

Helmets and Hand Shields

Helmets and hand shields are designed to provide protection against intense radiant energy not only for the eyes, but also for the face, ears, and neck. Typical operations which require helmets or hand shields include various kinds of arc welding and heavy gas cutting. Three types are described below.

1. **Helmets**. Because of the area to be protected, the helmet body is of such size and shape as to protect the face, top of the head, and the neck to a vertical line back of the ears. It has an opening or openings in the front for a filter plate and cover plate. The helmet body is supported by a head gear so that it does not come in contact with any part of the head and can be lifted up from in front of the face to allow the welder to examine the weld. The helmet body is made of vulcanized fiber, reinforced plastic, or other suitable heat- and flame-resistant material, opaque to visible ultra-violet and infra-red radiations and able to be disinfected. Rivets or other metal parts, if terminating on the inside surface, are insulated.

2. **Hand shields.** Hand shields are used in some welding operations or for observing the welding process. A handle made of nonconducting, noncombustible, or slow-burning material is used instead of a head gear. The materials used for hand shields are similar to those used for helmets. The lens-mounting arrangement and filter and cover plates are the same as for the helmet.

3. **Nonrigid helmets.** Helmets made of nonrigid materials are designed for use in confined spaces and are collapsible for convenience in carrying. The helmets are of the same general shape of the rigid helmet, except that a more complete covering of the top of the head is necessary to maintain the face, side, and windows in proper position. The requirements for the filter plates, cover plates, and lens-mounting frame are the same as for the rigid helmet.

Face Shields

Face shields are designed to provide protection to the face from flying particles and sprays of hazardous liquids and, in addition, to provide antiglare protection when needed. Plastics, used in the manufacture of face shields, combine a high degree of mechanical strength with lightness of weight, are nonirritating to the skin when exposed to perspiration, and are capable of withstanding frequent disinfection. Plastic materials should be slow burning. Clear or colored plastic materials used in windows should be of an optical grade to provide equivalent performance with the optical, physical, and radiant energy requirements specified for other eye protectors. When face shields are to be used in atmospheres or working areas requiring special conditions of nonconductivity or non-sparking, all materials used should be made to meet these requirements and plainly and permanently labeled as "nonconductive face shield" or "non-sparking face shield." Some typical uses for face shields include the following: woodworking operations where chips and particles fly; metal machining causing flying particles; buffing, polishing, wire brushing, and grinding operations where flying particles or objects may strike the face; spot welding; and handling of hot or corrosive materials. They are not acceptable for protection against heavy flying objects, for welding, cutting, or intense radiant energy; in such cases, where facial protection is needed, the face shield should be worn over appropriate goggles.

Care and Disinfection of Eye Protection

Good eye protective devices require clean lenses. Dirty lenses will blur vision and will eventually cause eye strain. Lenses should be cleaned daily with a solution of warm water and soap (or a cleaning solution) and wiped dry. Pitted or scratched lenses can also reduce vision and should be replaced with new lenses whenever possible. The molded-type plastic frames of protective covers lend themselves readily to lens replacement. Spectacle-type glass frames require professional skill to replace, and consideration should be given to replacing the entire safety goggle. Keeping goggles in their cases when not in use will extend their usable life span. The plastic bag or box in which they come provides an ideal dust-proof container for protection.

If a protective device is worn by more than one person, it will require a means of disinfection. The most effective method of disinfecting eye protective equipment is 1) thorough cleansing with soap and warm water; and 2) careful drying with tissue. A complete immersion in disinfecting solution for ten minutes is another way of disinfection. After such treatment the protective devices should be allowed to dry in room temperature, because wiping will destroy the germicidal residue which otherwise retains its effectiveness while in use. Disinfection under ultraviolet light is not recommended since this causes rapid deterioration of plastic and rubber parts.

Head and Ear Protection

Head and/or ear injuries are not common in the school shop or laboratory. However, there are certain school shop activities which warrant use of safety hats or ear protectors. For example, if the school offers a building trades curriculum, it would be advisable to equip students with one of the many new types of safety hats.

Safety or "hard" hats are usually made of fiberglass, plastic, or aluminum. They are lightweight, comfortable, durable, and designed to resist severe impact, penetration, and shock according to federal and other standards for hard hat safety.

The ease with which a strand of hair can be caught on a revolving shaft or other moving part or picked up by static electricity generated by a moving belt presents a special accident prevention problem when students with long hair work anywhere around moving machinery. Various forms of protection for women's hair have been developed and tried out. Attractively designed caps have proved effective and have been well received. They should be made of durable fabric to withstand regular laundering and disinfecting. The design should be simple so that they can be pressed or ironed by machine. A visor long enough and rigid enough to provide warning before the head strikes an object which might cause injury is advisable. A range of sizes sufficient to insure good fitting is important.

Ear protective devices are being used more and more in establishments where noise cannot be reduced at its point of origin. Ear protectors are designed to provide maximum ear protection by filtering out and absorbing harmful noise in both the high and low frequency. It is generally recognized that ear plugs alone significantly reduce noise at the eardrum. An ear muff attempts to seal out noise by providing a tight fit around the ear. Ear plugs should be individually fitted to the wearer. They are somewhat difficult to detect from a distance and should be inspected to insure that they are being worn where needed. The attenuation of noise by ear plugs is generally somewhat less than can be afforded by ear muffs. Ear muffs may be foam filled or grease filled. The latter costs somewhat more but are the most effective in attenuating sound pressure levels. Ear muffs are substantially more expensive than ear plugs and are more bulky but are sometimes more comfortable to wear.

Hand, Foot, and Leg Protection

The hands, legs, and feet account for approximately 60 percent of all disabling industrial injuries. In the school shop, injury to fingers is probably the most frequently occurring accident. Because it is necessary to handle work, the fingers are almost continually subject to injury. Legs and feet normally receive fewer injuries in the school shop, but even so, protection should be provided where the nature of the work permits such injuries to occur. A survey of the shop area will indicate where hand, foot, and leg protection should be worn.

Gloves and Hand Leathers

Canvas or heavy cotton work gloves are usually worn if the main hazard are blisters due to friction. Such protection is inexpensive and easily procured. When heat is involved, such as in foundry work, a more protective type of glove or mitten must be worn. Asbestos gloves or mittens are designed for the very hot jobs and made of long fiber asbestos cloth. For welding, a leather glove extending well over the wrist is recommended. Some of the more durable ones are made of cowhide or horsehide. Hand guards or leathers are usually of a special design to reduce hazards when handling material with sharp edges, such as sheet metal or steel. They consist of a pad of leather which covers the palm of the hand and fingers, yet permits maximum hand flexibility. For protection against acids, caustics, solvents, and petroleum products, an appropriate impermeable glove, available in various types of rubber or plastic, should be used. Such gloves can be purchased in wrist or gauntlet length. The gauntlets vary in length and extend to a few inches above the wrist or to the entire length of the arm, as required. Gloves should not be worn around moving machinery.

Foot Protection

A great majority of foot injuries occur from dropping heavy objects on the feet and getting toes caught under heavy objects as they are lowered. Safety shoes with steel toe boxes have been designed to prevent injury when such accidents occur. The modern safety shoe is quite stylish, and usually cannot be detected from ordinary street style oxfords or ankle high shoes. The difference lies in the hidden steel toe box installed in the shoe. Safety shoes do not cost much more than regular shoes, and a well-made and properly fitted safety shoe is as comfortable and stylish as any other. Some retail stores now render a special fitting service for safety shoe buyers. Externally worn foot protectors which slip over regular shoes are also available.

Leg Protection

Leggings of knee or hip length provide additional protection against spark, acid, and metal splashing. Foundrymen in particular should be concerned with the protection offered by leggings when pouring molten metals. Knee-length leggings are usually secured by means of a spring clip which makes them easy to put on and wear. A tuck-in flap protects the back of the legs and, if properly designed, will fit well over the shoes. Such devices are usually made of either asbestos, leather, or flame duct material.

Respiratory Protective Devices

In most school shops ventilation is usually more than adequate for normal operation of the class. However, in working with new materials, one must be aware of the possibility of air contamination and the possible need for respiratory protection for the safety and health of the students. The type of respiratory protective equipment must be selected only after determining the type of hazardous exposure involved. Undoubtedly, there have been many cases of injury caused by the improper use of respirators. For example, an ordinary filter type respirator designed for rock dust or paint spray will not protect against lead fumes; a canister respirator intended for carbon monoxide offers no protection when the air contaminant is carbon tetrachloride vapor. To aid in the selection of respiratory protective equipment the following procedures or steps should be taken:

1. Identify the substance or substances against which protection is necessary.
2. Obtain full knowledge of the hazards which each such substance offers and its significant properties.
3. Determine the conditions of exposure involved, including duration of exposure, contaminated concentration, and oxygen content of the air.
4. Determine what, if any, personal characteristics and capabilities are essential for the safe use of the protective devices and procedures required.
5. Determine what facilities are needed for maintenance.

Finally, in view of these conditions, select the type or types of U. S. Bureau of Mines-approved respiratory device best calculated as adequate protection against the specific hazard and conditions.

Filter Respirators

Probably the most needed type of respiratory equipment in the school shop is for paint spray and fumes. This type of respiratory protection consists of a face piece or a half mask shaped to fit the contours of the face and equipped with a filter designed to trap fine particles of dust and paint from the air as it is inhaled, but must be carefully selected as indicated above for protection against specific hazards under specific conditions. Filter respirators are available for several types of dusts, fumes, and mists. Care of mechanical filters is simplified by selecting a model that can be easily cleaned, disinfected, and repaired. Naturally, no one wants to use a respirator that has been worn by another person until it has been disinfected. The manufacturer's directions should be followed in properly preparing a respirator for use by more than one person.

Other Respirators

Other respiratory devices of an oxygen or canister type are available for severe hazards of fire fighting and complex industrial uses. It is unlikely such equipment will be needed for school shop protection, except in an emergency. In fact, if the hazards are determined to be great enough to warrant use of this type equipment, the hazard should be eliminated or removed from the instructional program. In chemical laboratories the possibility of requiring emergency respiratory protection, including the self-contained type of breathing apparatus, should be carefully evaluated well in advance of need.

Protective Clothing

Auxiliary protection of a less spectacular type worn in many school shops consists of shop coats, aprons, coveralls, and overalls. These items serve as much a part of proper dress for specific job operations as do safety devices previously mentioned. Each has its specific function which should be considered as part of the total personal protective program.

Shop Coats

Shop coats give general body protection. Frequently they are used to safeguard against grease and dirt. More specifically, they serve as protection from chemicals and hot substances. Coats with sleeves should not be used when working around moving machinery. The short sleeve wraparound knee or hip length serves well for general laboratory or shop use.

Aprons

Aprons, available in a variety of materials, may be either the bib type covering from the chest down to the knees or ankles or of the waist type. Aprons protect against sparks, hot metal splashes, and splashing liquids depending on the material from which they are made. Loose aprons create an extremely hazardous situation when worn around revolving or reciprocating machinery and should not be permitted.

Coveralls and Overalls

Coveralls cover the body except for the hands, head, and feet. Overalls include a "bib" but do not have sleeves as provided in coveralls. They are usually made from a rugged material to withstand hard and long wear. Coveralls and overalls provide body protection and are recommended for building construction jobs.

First Aid

Most educational institutions have established policies for dealing with student injuries and illnesses and with the administration of first aid. All shop and laboratory teachers should become familiar with the policies of their particular school systems, so that they can act effectively and efficiently in case of student injury. Such policies are established primarily to assure the student a prompt and adequate treatment. However, they also prevent school personnel from taking any action for which the school administration is unwilling to accept legal responsibility. These established policies and procedures should be posted in the activity area so that all can see and act accordingly.

In schools where nurses are in attendance, it is preferable that they be delegated the responsibility for first aid because of their specialized training and experience. However, even if a nurse is available in the school, teachers should be qualified in first aid so that precious minutes can be saved in an emergency. Delay in caring for even small cuts and scratches can also have serious results.

The practice of permitting a student to care for his own injuries must be discouraged. The teacher should be informed about every classroom injury. Likewise, indiscriminate use of the first aid kit by students must be discouraged; it should be used only under supervision. The limitations of first aid must be thoroughly understood, and it is important that the teacher, or one appointed by him to look after school shop first aid work, have full understanding of these limitations.

There is general agreement that every school shop and laboratory should be equipped with a well-stocked first aid kit kept under supervision. However, the teacher should definitely determine the policy of the school administration regarding giving first aid in activity areas. There are three types of first aid kits which could be used in the school shop and laboratory situation:

1. Emergency kits containing only the essential articles for immediate treatment of injuries.
2. Group or departmental kits for the use of groups of shops or for a single department containing larger quantities of first aid articles.
3. First-aid room kits of a somewhat larger type, for use under the supervision of medical personnel.

Green has been specified by the United States of America Standards Institute as the basic color for designating "safety" and the location of first aid equipment. Such equipment includes first aid kits, safety bulletin boards, stretchers, first aid dispensary, and gas masks. The white cross on a green background identifies cabinets containing first aid materials. Such cabinets should be dust proof, clean, and well stocked with approved first aid materials. Maintenance of materials is simplified if each cabinet or kit contains a list showing the original contents and the quantities below which new materials should be ordered. The periodic and scheduled inspection and stocking of first aid kits should be the responsibility of the teacher, assisted by an assigned responsible student.

INSPECTIONS

Safety inspections are a necessary segment of a complete accident prevention program. They are essential to maintaining acceptable standards of safety for physical facilities and working practices. Conditions in school shops and laboratories are constantly changing. Materials are moved, storage racks are depleted, waste materials accumulate, and machine, hand tools, and other equipment are constantly changing as a result of use, wear, or abuse. Changes also result from student turnover from one class period to another and from the student's progression from one activity to another. Safety inspections are a means of surveying and appraising the problem of unsafe conditions and work practices which result from these many types of changes.

TYPES OF INSPECTIONS

There are several types of inspections which should be employed in the school shop and laboratory situation. They may be classified as follows: 1) periodic inspections, 2) intermittent inspections, 3) continuous inspections, and 4) special inspections.

Periodic Inspections

Periodic inspections are those which are scheduled to be made at regular intervals. Such inspections may be made daily, monthly, semiannually, annually, or at other suitable intervals. Such inspections should be well planned so that they may be made with dispatch and efficiency. A "suspense" file should be set-up so that those individuals involved can be notified beforehand to make the necessary preparations.

Periodic inspections may be in the form of **general inspections**. A general inspection will cover the entire school shop situation, department by department, room by room, machine by machine, operation by operation, until the most remote corners of all the facilities have been thoroughly investigated, not excluding those places where no one ever visits and where no one ever gets hurt. Many of these out-of-the-way places are overhead, where it is difficult to see the hazard from the shop floor.

Periodic inspection may also take the form of **fire inspections**. One of the greatest hazards to a school plant is fire. Consequently, a rigid system should be set up for periodic inspection of all types of fire protective equipment. The schedule for inspections should be closely followed and an accurate record kept of each piece of equipment inspected and tested. Along with the scheduled inspection, the adequacy and type of equipment needed should be carefully surveyed. As new operations and processes are added to the shop or laboratory curriculum, new fire hazards may be introduced. These new devices and procedures will require individual treatment and may need special extinguishing devices.

Other periodic inspections include the regular checking of floors and flooring. At the same time, attention should be paid to fall-causing hazards such as slippery, wet, oily, and worn floors; loose material underfoot; worn or broken treads on stairs; insecure scaffolds and platforms; stairs, scaffolds and platforms with no hand rails; defective ladders or ladders not suited to the job; unguarded floor openings and manholes.

Many types of tools, machines, and processes require periodic inspections if they are to be operated safely. Some shop teachers require the tool clerk to make a safety check of all tools and accessories when they are returned to the tool crib for storage and again before reissue. Some teachers send all portable electric tools and extension cords to the electric shop between the first and tenth of each month. In the electric shop, students inspect the tools and make the necessary repairs. Colored tags are attached to the tools and cords showing the month the equipment was last inspected.

Intermittent Inspections

These are inspections which are made at irregular intervals as the need arises. They may be unannounced and deal with a particular shop, laboratory or a specific piece of equipment. The need for this type of inspection is frequently indicated by the accident tabulations and analysis. Should an analysis show an unusual number of accidents for a particular location or an increase in certain types of injuries, inspections should be made to determine the reasons for the increase and the necessary corrective action.

Continuous Inspections

These are inspections set up so that selected students spend a predetermined amount of their time observing or inspecting certain equipment and operations for hazards and unsafe practices. Such students are often called safety foremen. This type of inspection should be rotated so that all qualified students will have a part in the safety activity, thus making a contribution to the accident prevention program. This method of inspection provides an opportunity for students to become familiar with the exact safe condition of tools and machines. It enables the students and the instructor to learn of weaknesses and defects long before they can become hazardous. A continuous system of inspection of personal protective equipment is especially desirable. A constant check of goggles, respirators, gloves, and other protective clothing will insure the maintenance of this equipment in safe and usable condition.

Special Inspections

These inspections are sometimes necessary because of the installation of new equipment, the introduction of a new operation or process, the remodeling or repair of a piece of equipment or shop facility, or because new situations or circumstances introduce new hazards. Special inspections may also be made during campaigns such as Fire Prevention Week, waste elimination campaigns, prior to a shop "open house," or other special programs. The investigation of accidents requires special inspection conducted by assigned individuals. Such inspections should be made with thoroughness and a determination to control accident causes.

The **health survey** is a type of special inspection made to determine the extent of suspected health hazards and to determine precautions or mechanical safeguarding necessary to provide and maintain safe conditions. It may be necessary to call upon health department specialists to conduct this type of special inspection.

Safety Inspectors

Although the principal purpose of safety inspections is hazard detection and correction, there are numerous worthwhile side effects. Involving students in these inspections helps to teach the duties of the industrial foreman in accident prevention. Involving teachers and educational supervisors demonstrates the interest and sincerity of these school authorities in the continued safety of students enrolled in shop and laboratory programs. When representatives of industry or governmental agencies are also involved, the students are likely to adopt a more positive attitude toward the accident prevention program as a whole and use their own initiative in detecting unsafe conditions and work practices.

Safety inspections in schools may be made by 1) school personnel, 2) industrial safety engineers, 3) inspectors from state departments of labor and industry, 4) state and local fire inspectors, 5) student safety committees, and 6) student inspectors or foremen.

School Personnel

This group might include educational administrators, supervisors, or teachers on a state or local level. State directors, supervisors, teacher educators, or coordinators of vocational education can be invited to serve in special inspections when the interests of the statewide shop and laboratory program are involved, or when there is an unusually high accident rate. Local vocational supervisory personnel should be employed also to a considerable extent in periodic and/or special inspections.

Industrial Satety Engineers

Professional safety engineers in local industries can aid greatly in making a school shop inspection program more effective. These individuals, serving voluntarily, have training and experience in organizing and operating safety inspection programs. It is advisable, however, to make arrangments well in advance of the school year if the service of these men is to be expected.

State Labor Department Inspectors

The shop and laboratory teacher should become familiar with the accident prevention services available from his state labor department. These services will vary from state to state, but the teacher will find these officials more cooperative. In most states labor department inspectors are only available on request.

Fire Inspectors

Persons who make fire prevention inspections should be particularly well informed and sensitive to hazards which may cause fires. Local fire departments are usually anxious to cooperate with fire prevention in schools. As a part of periodic inspections, it would be well for shop teachers or supervisors to invite representatives of local companies to inspect for hazards and to give technical advice on fire prevention.

Student Safety Committees

The student safety committees can be formed either on a school-wide basis or on a shop or laboratory basis. The latter plan provides an opportunity for more shop students to participate, resulting in greater educational benefits. The most important duties of such a committee are inspection of the shop area for accident hazards and unsafe practices and the investigation of accidents to prevent recurrences.

Student Safety Foremen

Many shop and laboratory teachers find it helpful to appoint student safety foremen to assist in carrying out the shop safety inspection program. A student safety foreman is especially useful in the continuous type of inspection. All qualified students should have the opportunity of serving in this capacity by means of a rotation system. When serving as an inspector, the student should devote the majority of his shop time to accident prevention work; necessarily, his tenure in office will be brief in order not to interrupt his own shop training.

Inspection Procedure

Inspection procedures will vary considerably with different shops and with the types of inspections made. The primary objective of a well-balanced inspection program should be to determine whether everything is satisfactory, rather than to find out what is wrong. Procedures followed in safety inspections are comparable in many respects to those followed in preventive medicine. The steps include the following:

1. **Detect.** Examine the shop and its activities for possible hazards and unsafe practices. (Examine the patient for symptoms of illness or disease.)
2. **Analyze.** Analyze the particular hazards or unsafe practices for potential accident producing capabilities. (Diagnose)
3. **Correct.** Recommend the corrective measures. (Write the prescription or advise the necessary action to avert illness.)

Preparation is an essential requirement for effective safety inspections. Before one starts the inspection, the shop's accident history should be completely analyzed. This analysis should show the number of accidents, agencies involved, the nature of the injuries, and the accident causes. Attention should also be given to "near" accidents, and previous inspection reports should be reviewed. Emphasis should be made on causes, not blame, and an attempt should be made to discover why the condition exists, as well as what the condition is. Complete notes should be taken during the course of the inspection. These notes will form the basis for a report to be prepared later. As unsafe conditions and practices are discovered, they should be discussed with the instructor or shop supervisor and suggestions for corrections solicited. A definite policy should be established in regard to placing unsafe equipment out of service. Special danger tags can be employed effectively in preventing the use of machines and tools that have become unsafe through wear, abuse, or defects. However, such practices should be employed under the strictest supervision.

Inspection Check Lists

Numerous state and local school systems have developed safety inspection check lists adapted to their own needs. The National Commission on Safety Education of the National Education Association has published a general check list of safety education for schools. This list can serve as an excellent guide for the preparation of shop or laboratory safety inspection check lists. In preparing such an inspection check list, the number of basic factors depends upon the size of the shop or laboratory and the educational activity conducted in the area. The U. S. Department of Labor suggests the following as being a minimum of things to be investigated in industry:[16]

1. The condition of the building and facilities.
2. The layout of the work area with respect to the location and guarding of machines and equipment.
3. The access to and from the work area and the adequacy of aisles and storage areas.
4. The flow of the materials through the shop, including the disposal of scrap.
5. The handling of materials.
6. The control of hazardous materials.
7. The control of hazardous processes.
8. Lighting, noise, ventilation, heat and humidity, vibration and other related environmental exposures.

AVA-NSC Check List

One of the most objective safety check lists available to shop teachers today is the *National Standard School Shop Safety Inspection Check List* prepared by the joint safety committee of the American Vocational Association and the National Safety Council. This four-page form is available from the National Safety Council at a very nominal price.

Implementation of the use of this instrument will require an organized action program with support and leadership from state educational agencies, from local educational leaders, and from teacher education institutions.

ACCIDENT REPORTING AND ANALYSIS

An organized system of accident reporting and analysis can contribute materially to the success of the school shop and laboratory accident prevention program. Such a system, however, is much more than a simple amassing of data. It is the discovery and investigation of facts pertaining to an accident, an analysis of this data, a deduction of the underlying causes and a consideration of possible corrective action.

An excellent publication entitled *Student Accident Reporting Guidebook*[17] is available to state and local administrators from the National Safety Council. This guidebook discusses in detail every facet of an accident reporting system. It tells how to develop a report form, how to compile data, and how to use the information. It briefly discusses how elements of a safety program affect the reporting system. It offers a standardized terminology, definitions of accidents and injuries, and rate computations. All are designed to make it easier for school personnel to understand their own accident experience, and to be able to look at local and national information with more understanding. The balance of this section of the Guide will briefly summarize the basic elements of the National Safety Council guidebook.

Use of Reports and Records

There are literally hundreds of uses for accident data. The teacher, the nurse, the principal, the safety supervisor, the departmental supervisor, the superintendent, the board, and the community all can effectively use information from school accident records and reports. Specifically, the systematic accumulation of school and non-school jurisdictional accident and injury data will provide the school superintendent with information upon which to base:

1. Curriculum guidance to educate the child for safe living.
2. A realistic evaluation of safety program efforts on a regular basis.
3. Changes in building structures and facilities or procedures to improve the environment of the school system.
4. Organizational and administrative improvements to strengthen the management aspects of the safety program.

5. A strong public relations program, thus lessening public demands for crash programs of little value, should unusual incidents occur.

6. A strong leadership role in community safety efforts.

7. An assessment of the costs of accidents and injuries and their relationship to the operating expenses of the school system.

Individual accident reports can be useful at any level of the school system for positive action (including defense of a lawsuit following an injury), and they should be reviewed carefully at each level through which they are processed. The principal has many uses for an individual accident report. For example, he may use the report to:

1. Check on what is happening in his school.

2. Spot an unsafe condition or unsafe procedure which can be corrected locally by the custodian or by the principal himself; the report can provide the basis for a work order for repair and maintenance of facilities.

3. Initiate special safety studies within the school.

4. Strengthen staff interest in accident prevention activities by having members of the staff, such as the faculty safety coordinator, nurse, or custodian review the report and make recommendations.

5. Establish a repeater file, and also note the accidents in the student's personal folder for reference throughout his school years.

The school system's safety supervisor is normally the next person to review each report. He may use the report to:

1. Spot unsafe conditions or deficiencies not recognized at the school level and which can be corrected at his level.

2. Initiate special studies when unusual accidents appear.

3. Watch for trends in normal activities so that immediate analytic and preventive action can be taken in cases of rising trends.

4. Initiate procedural studies and changes.

5. Emphasize a particular subject area in regular or special bulletins.

6. Alert supervisors in other departments, such as physical education, elementary, industrial arts, science, and medical departments, to incidents relative to their specialty and to ask for their recommendations or suggestions.

7. Spot weaknesses in the reporting procedure which can be corrected or minimized.

8. Screen out unusual occurrences which will provide a little levity or change of pace for bulletin material.

9. Keep the superintendent fully informed of serious or unusual incidents in case of inquiry by the board or other local officials.

10. Keep the business or law office informed of reports which may have legal implications.

11. Establish a repeater file at the school system level for the purposes of special studies.

Use of Monthly Summary Reports

Although individual accident reports may not be too meaningful, when they are viewed as a group they may be very useful in that they can reveal patterns. Therefore, reports should be accumulated, compiled, analyzed regularly, and summarized monthly. Within the school, summaries may serve a number of purposes. The principal can use the reports as the basis for:

1. Initiating special projects for the student safety council or the safety committee of the student council.

2. Initiating special studies of problem areas by teachers, parents, or students.

3. Requesting assistance from the consultant staff to solve special school safety problems.

4. Comparing current accident experience with past records to determine trends.

5. Reviewing course material within the school classes and activities in order to insure proper emphasis on safety.

6. Discussing school safety problems with the teachers and administrative staff at the principal's regular meetings.

The safety supervisor can make substantial use of monthly summaries. Here are some of the more important uses:

1. To identify the principal types of accidents, where and why they are occurring, and what to do about them. Corrective action may take various forms: improved instructional material; increased teacher education; changes in procedure or supervision; additional safety instruction; or structural or physical changes in the school environment.

2. To compare the accident experience this month to corresponding previous months. Was it up or down? What areas have improved or retrogressed? What are the general trends and causative factors involved? Are there any schools which appear to have an uptrend from the previous month?

3. To use observations and findings as a basis for special emphasis material presented to principals and teachers through monthly safety bulletins or other media.

4. To prepare a short synopsis for the superintendent to keep him abreast with his program. Give him brief facts and figures meaningful from a management standpoint.

5. To keep the department-level staff informed of accidents and trends within their area of interests. Encourage continuing interest and action on their part.

6. To watch for trends as a basis for special and continuing studies.

Use of Yearly Summaries and Analyses

Yearly compilations and analyses can have broader implications in many cases, because they present a greater body of material than do monthly summaries. Almost all the uses of monthly summaries also pertain to yearly summaries, and the same principles for use are involved. Some additional ideas for use of annual data include:

1. The preparation, publication, and distribution of annual reports to schools, consultant staffs, school boards, superintendent, and outside agencies.

2. Use trend analyses to determine planning for the next year, and for instigation of special studies for curriculum planning.

3. Encourage individual schools to summarize and analyze their own reports on a yearly basis, utilizing the same principles as for monthly reports.

4. Analyses of data can be used for justification to the superintendent and board of education of additional safety staff or additional funding. The safety supervisor is in the best position to present a case for staffing to the superintendent.

5. Yearly analyses can provide data for improvements in school construction or modifications.

6. Accident reporting procedures should be reviewed each year, and summaries may indicate that a change in some procedure is needed.

7. Annual reports can indicate a need for additional education or change in emphasis for students and staff.

8. Annual reports must be used as a factor for appraising a school's progress in an overall safety program.

Reportable and Recordable Accidents

Basic to the establishment and standardization of a reporting system is an understanding of terms and definitions. The definitions given below should be thoroughly studied and understood before proceeding. Discussion of the terms will follow the definitions to amplify the concept.

The purpose of distinguishing between types and severity of accidents is twofold. First to provide the school with information relative to all school jurisdictional accidents and with non-school jurisdictional accidents causing injury to pupils; and second to provide a standard method with a common base in order to compare and analyze accident and injury data within the school system, with other school systems, or with national statistics. The terms used to distinguish these purposes are **reportable** (any accident for which a report is filled out) and recordable (any accident to be included in standardized statistical treatment of the data).

Reportable Accidents

A reportable accident is 1) any school jurisdictional accident which results in any injury to a student and/or property damage; or 2) any non-school jurisdictional accident which results in injury causing restriction of activity of the student. School jurisdiction includes school buildings, grounds, to and from school, and school-sponsored activities away from school property. The concept of property damage includes damage to the school's own equipment, material, or structures, or damage to non-school property as a result of a school jurisdictional accident. Restriction of activity implies a loss of one-half day or more of school time or a loss of one-half day or more of normal activity if during a non-school period.

Every school system should require a report of some kind on the accidents they consider as reportable. It is essential that a school system know of all accidents occurring under the school's jurisdiction. This is sound management procedure, and it offers some protection for the school in areas where liability may be a factor.

Recordable Accidents

A recordable accident is any accident which results in: 1) student injury severe enough to cause loss of one-half day or more of school time; or 2) student injury severe enough to cause loss of one-half day or more of student activity during non-school time; and/or 3) any property damage as a result of a school jurisdictional accident. For standardization a one-half day loss of school time is defined as one half of the normal school day for the particular student involved.

"Reportable only" accidents are not included with recordable accidents for the purpose of summary and analysis as there can be no standardization either within or without a school system if it is done. The number of local and other influences, even in individual schools within a school system, precludes the feasibility of this practice. Thus, identifying a recordable accident provides a basis for a standard method for summarizing and analyzing accident and injury data; not only within the school system itself but with other systems, and with state, regional, and national figures. Recordable injuries and accidents, therefore, are used as the basis to develop summary charts and perform statistical analysis.

Accident Report Forms

It is recognized that there is no one report form that will satisfy the needs of every school system. There is no one format that can be said to be better than any other, but the report form should be simple and as easy as possible to complete. In addition, there is a required body of information which is basic to the analysis and utilization of accident and injury data if the report is to have any value for accident prevention purposes.

For information and background, the items which should make up the minimum content of an accident report form are herein defined. The terms used are consistent with accident reporting terminology used in accident prevention work throughout the country. Their use in school reporting systems helps to standardize terminology and makes it much easier for written and verbal communication among safety personnel. As a further aid to understanding each of these general classifications, they are shown on a sample accident report form following. Items 4 through 24 are described below:

4. **Sex**. Indicate "M" for male; "F" for female; "Unknown" for unknown; or "NA" for not applicable. The "NA" will indicate property damage accidents with no personal injury involved.

5. **Age**. State age of the student at the last birthday.

6. **Grade**. Indicate the grade level such as K for kindergarten, 1- for first grade, 2- for second grade; special education; adult education; junior college. If it is a special program such as Headstart, Student Work Program, Adult Retraining or Preprimary, indicate each.

7. **Date, time, and day of accident**. Indicate the month, the day of the month, the year, the exact time a.m. or p.m., and the day of the week the accident occurred.

8. **Nature of injury**. Indicate to the best of your knowledge what the injury was, such as burn, fracture, abrasion. If multiple injuries, list only the most serious.

9. **Part of the body injured**. Indicate the part of the body injured such as lower arm, ankle, scalp. If more than one part of the body is injured, indicate the most severe or list it as a multiple injury.

10. **Degree of injury**.

    a. Indicate death if fatal.

    b. Permanent total or permanent partial disability if the injury results in the complete loss or loss of use of a body part or parts, such as the loss of an eye or the loss of a limb, amputation of a part of the body.

    c. Temporary total disability if the injury does not cause permanent disability, but causes the individual to lose one-half day or more of school or one-half day or more of normal activity if during a non-school period.

    d. No lost time if the injury did not cause permanent disability and/or loss of time or loss of activity.

    e. If degree of the injury is not immediately known, estimate or use a follow-up system. Reports should not be held up for lack of this information.

11. **Number of days lost**. Indicate, from one-half day or more, the number of days that the student was absent from school, or the number of days from one-half day or more that the student was restricted from normal activities if during a non-school period. For the purposes of this guide, a one-half day loss in school is defined as one half of the normal school day for that particular student. If lost time is not immediately known, estimate or use a follow-up system. Reports should not be held up for lack of this information.

12. **Cause of Injury**. Identify the event which resulted in the injury such as "struck against moving object," "fall from elevation," "rubbed or abraded," "overexertion."

13. **Jurisdictional classification of accident**. Indicate specifically whether accident was under school or non-school jurisdiction, such as school building, to and from school, home, or other.

14. **Location of accident**. Indicate the exact location of the accident.

15. **Activity of the person**. Indicate what the person was doing at the time of the accident.

16. **Status of activity**. Indicate the status of the activity at the time of the accident. For example, regular classroom period, physical education class, intramural athletics and practice, interscholastic athletics and practice, shop period, laboratory period, lunch hour period.

17. **Supervision**. Indicate whether an adult was present at the scene of the accident, and, if so, whether this adult was a teacher, another school employee, the parent, or another adult.

18. **Agency**. Indicate the equipment, substance, material, or the thing most closely related to the accident.

19. **Unsafe act**. Indicate any act on the part of the person or persons involved which may have caused or contributed to the accident.

20. **Unsafe mechanical or physical condition**. Indicate the primary unsafe mechanical or physical conditions, if there were any.

21. **Unsafe personal factor**. Indicate if there was any unsafe personal factor associated with the individual injured that may have contributed to the accident. Example: bodily defect, such as defective hearing; lack of knowledge, skill or experience, such as failure to recognize hazards; improper attitude, such as total disregard of instructions.

22. **Action taken or recommended to prevent further accidents of the same type**. Indicate what action was taken locally and/or (further) action recommended (i.e., action which may not be under the purview of local school personnel.)

23. **Property damage**. Indicate in dollars the amount of damage, if any, to school and/or other property as a result of the accident.

24. **Description.** Briefly give a word picture of the accident, explaining the who, what, where, when, why, and how of the accident. Include such items as weather, equipment, unsafe conditions, unsafe acts, personal factors, and whether other persons may have contributed to the accident and how.

If accident report forms are to be worthwhile for accident prevention purposes, the individuals completing and reviewing the report must know why they report accidents, how to fill out the forms, and what the items mean. Simple, clear, and meaningful instructions must be given to all concerned. Any, or preferably all, of the following methods can be used to disseminate instructions:

1. Print the instructions in the safety handbook or in the administrative manuals, to be available in each school or other building.

2. Print the instructions in separate written form, such as in a pamphlet, a mimeographed bulletin, or printed instruction sheets for individual handout. This can be done in addition to the material already included in the administrative manuals, particularly if distribution of the latter is limited.

3. Print instructions on the back of the report form.

Jonesville Public Schools
ACCIDENT REPORT FORM

1. NAME______________________ 2. ADDRESS______________________

3. SCHOOL______________________ 4. SEX______ 5. AGE______ 6. GRADE__________

7. DATE AND TIME OF ACCIDENT, DAY OF WEEK______________________

8. NATURE OF INJURY______________________ 9. PART OF BODY INJURED______________________

10. DEGREE OF INJURY______________________ 11. NUMBER OF DAYS LOST______________________

12. CAUSE OF INJURY______________________

13. JURISDICTIONAL CLASSIFICATION OF ACCIDENT______________________

14. LOCATION OF ACCIDENT______________________

15. ACTIVITY OF PERSON______________________

16. STATUS OF ACTIVITY______________________

17. SUPERVISION______________________

18. AGENCY INVOLVED______________________

19. UNSAFE ACT______________________

20. UNSAFE MECHANICAL OR PHYSICAL CONDITION______________________

____

21. UNSAFE PERSONAL FACTOR______________________

22. CORRECTIVE ACTION TAKEN OR RECOMMENDED______________________

____

23. PROPERTY DAMAGE______________________

24. DESCRIPTION OF ACCIDENT______________________

____

____

25. DATE OF REPORT______________________

26. REPORT PREPARED BY______________________ PRINCIPAL______________________

Fig.

REFERENCES

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7. National Safety Council, *op. cit.* p. 2-17.
8. U.S. Department of Labor, Bureau of Labor Standards, *Maintenance and Safety*, Bulletin 246, p. 1.
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10. National Safety Council, *op. cit.* p. 16-33.
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15. Williams (ed.), *op. cit.* p. 327.
16. U.S. Department of Labor, Bureau of Labor Standards, *Control of the Physical Environment*, Bulletin 211, p. 2.
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APPENDIX B
MINOR TOOLS AND EQUIPMENT

APPENDIX B
MINOR TOOLS AND EQUIPMENT

*Quantity	Item	**Priority	*Quantity	Item	**Priority
2	Plane, Block	1	2	Plane, Jack	1
1	Plane, Smoothing	1	1	Plane, Rabbet, Stanley No. 78	1
1	Plane, Fore on Jointer	1	1	Plier, Fence	1
1	Plier, Locking Jaw	1	2	Pliers, Pump, Arc Joint, 2 1/8 in. Cap.	1
3	Pliers, Slip Joint, 8 inch	1	2	Plumb Bob	1
1	Rake, Garden	1	1	Reamer, Pipe 1/2 in. to 2 in.	1
1	Torch, Gasoline	2	12	Tape, Steel, 12 ft.	1
12	Safety Equipment, Hard Hat	1	2	Saw, Back	1
3	Saw, Cross Cut 8 pt.	1	2	Saw, Crosscut, 10 pt.	1
1	Saw, Dovetail	1	2	Saw, Hack, Adj.	1
1	Saw, Coping	1	2	Scraper, Cabinet	1
2	Scrapers, Paint	1	2	Saw, Key Hole, 10 in.	1
2	Saw, Rip, 5½ pt.	1	1	Set Screwdriver, Phillips, No. 1-3 in., No. 2-4 in., No. 3-6 in.	
1	Set, Screwdriver, 3/8 in. x 12 in., 3/16 in. x 8 in., 1/4 in. x 6 in., 1/8 in. x 4 in.	1	10	Scrapers, 3 in. x 5 in.	1
			1	Stone, Sharpening	1
1	Snips, Tin	1	2	Shovels, Square Point	1
2	Shovels, Round Point	1	2	Soldering Irons	1
2	Shovels, Sand	1	6	Squares Framing, 24 in.	1
2	Snips, Tin, Set, Straight, R. Hand, L. Hand	1	12	Squares Combination	1
1	Square, Combination, Set	1	4	Square, T-Bevel	1
1	Stapler, Hammer, Hand-Operated	1	1	Stapler, Gun, Hand-Operated	1
2	Tape, 50 ft.	1	1	Tape, 100 ft.	1
4	Tarpaulins, 9 ft. x 12 ft.	2	1	Tools, Cement Set	1
1	Tools, Drywall, Set	1	1	Tools, Masonry, Set	1
1	Tools, Plasterers, Set	2	1	Tools, Paper Hanger, Set	2
1	Torch, Soldering Kit	1	1	Vice, Machinist Service Base 7 in. Cap.	1
1	Vise, Woodworkers, Port.	1	1	Wrench Adj., Set 6 in.–8 in., 10 in.–12 in.	1
1	Wrench, Basin	2	4	Wrench, Pipe, 10 in.–24 in.	1
1	Wrench, Set, Open End 3/8 in.–1 in.	1	1	Axe, Single Bit	1

*Based on a class of 15 students with emphasis on individualized instruction

**Priorities–1. Recommended minimum to initiate program
2. Needed for full cluster
3. Needed for in-depth training

MINOR TOOLS AND EQUIPMENT

*Quantity	Item	**Priority
3	Bar, Ripping, Gooseneck	1
1	Bit, Counter Sink	1
2	Bit, Electricians, 3/8 in. x 18 in.	1
1	Bit Set, Large Hole	1
1	Bit Set, Screwdriver	1
As Needed	Brushes, Asstd Sizes	1
2	Chalkline	1
1	Chisel Set, Cold 3/8 in.–3/4 in.	1
4	Clamps, Band 1 in. wide x 15 ft. long	1
4	Clamps, C, 3 in.	1
8	Clamps, C, 6 in.	1
6	Clamp, Spring	1
2	Cord, Elec. Extension	1
1	Cutter, Circle	1
1	Cutter, Tubing & Flaring Tool	1
1	Dividers Wing	1
1	Drill Set, H.S. 1/16 in.–1/2 in. by 64ths w/index	1
1	Gun, Caulking, Cartridge	1
8	Hammer, Curved Claw, 1602	1
1	Hammer, Ball Peen	1
2	Hammer, Sledge, No. 8	1
3	Hatchets, Shingle	1
3	Hose, Garden 5/8 in. x 50 ft.	1
6	Knife, Putty, Asstd.	1
1	Knife, Stripping 14 in.	1
1	Ladder, Ext. 18 ft.–24 ft.	1
2	Level, 24 in. Aluminum	1
1	Level, 78 in., Aluminum	1
3	Level, Line	1
3	Bar, Ripping, Straight	1
3	Bar, Ripping, Cats Claw	1
2 sets	Bit set, Auger 1/9 in.–1 in.	1
2	Bit, Expansion, to 3 in.	1
1	Bit Set, Power Spade	1
1	Brace, Hand Ratchet	1
2	Burnisher	1
3 sets	Chisel Set, Wood Asst. 1/4 in.–2 in.	1
2	Chisels, Ripping	1
2	Clamps, Band, 25 ft.	2
8	Clamps, C, 4 in.	1
4	Clamps, C, 8 in.	1
1	Cord, Elec. Extension	1
1	Cutter, Bolt, 1/2 in. Cap.	1
1	Cutter, Pipe, 2 in. Cap.	1
1	Dado Head Quickset	1
1	Drill, Push	1
3	Gauge, Marking	1
1	Gun, Soldering, 2,000 Watts	1
6	Hammer, Straight Claw Ripping 2002	1
2	Hammer, Engineer, No. 3	1
2	Hammer, Tack	1
1	Hoe, Mortar	1
2	Knife, Linoleum	1
2	Knife, Utility	1
2	Ladders, Step 6 ft.–8 ft.	1
1 pr.	Ladder Jacks	1
1	Level, 48 in., Aluminum	1
1	Level, Hand Eye	3
4	Mallet, Wood	1

*Based on a class of 15 students with emphasis on individualized instruction

**Priorities–1. Recommended minimum to initiate program
2. Needed for full cluster
3. Needed for in-depth training

MAJOR EQUIPMENT

*Quantity	Item	**Priority
1	Compressor 50 CFM, Portable	3
1	Drill, Portable 3/8 in. Cap.	1
1	Furnace, Lead Melting With Pot & Ladle	2
1	Grinder, Portable, Electric	3
1	Hammer, Air Portable	3
1	Jointer, 6 in.	1
2	Ladders, Extension, 18 ft. or longer	1
1	Level, Transit Builders With Tripod and Sighting Rod	1
1	Mixer, Concrete	2
1	Router, Portable With Acces., Butt Hinge Template Kit	1
1	Sander, Orbital	1
1	Saw, Circular, Direct Drive, 7 1/4 in. With Asstd. Blades	1
1	Saw, Chain	3
1	Saw, Portable Jig (Sabre)	1
1	Saw, Radial Arm 10 in.–12 in. With Asstd. Blades	1
1	Screwdriver, Portable, Electric	3
1	Stapler, Portable Air	3
1	Threader, Pipe 1/2 in.–2 in.	1
1	Vibrator, Electric	3
1	Wheelbarrow	1
1	Welder & Cutting, Oxy-Acety.	3
1	Drill, Portable 1/4 in. Cap.	1
1	Drill, Portable 1/2 in. Cap.	1
1	Grinder, Pedestal	1
1	Hammer, Impact Elec.	3
1	Hoist, Chain, 1 Ton	3
2	Ladders, Step, 6 ft. & 8 ft.	1
2	Ladder Jacks	1
1	Mitre Box	1
1	Planer, Portable, Elec.	1
1	Sander, Belt Port.	1
1	Saw, Circular, Table With Acces.	2
1	Saw, Circular, Worm Gear Dr. 7 1/4 in.	1
1	Saw, Masonary	2
1	Saw, Power, Metal Cutting	2
1	Saw, Heavy Duty Reciprocating	3
1	Spray Gun, Paint Outfit	3
1	Trimmer, Laminate	2
2	Vacuum, Portable Shop With Attach.	3
1	Vise, Pipe With Stand	1
1	Welder, Elec. Arc	3
1	Wrench Set, Socket, 1/2 in. Dr. 7/16 in. x 1 1/8 in.	1

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*Based on a class of 15 students with emphasis on individualized instruction

**Priorities–1. Recommended minimum to initiate program
2. Needed for full cluster
3. Needed for in-depth training

APPENDIX C

DIRECTORY OF MEDIA PRODUCERS AND DISTRIBUTORS

APPENDIX C

DIRECTORY OF MEDIA PRODUCERS AND DISTRIBUTORS

Acoustical and Insulating Materials Association
205 West Touhy Avenue
Park Ridge, Illinois 60068

Adjustable Clamp Company
414 N. Ashland Avenue
Chicago, Illinois 60622

Aims Instructional Media Services, Inc.
P.O. Box 1010
Hollywood, California 90028

Alcoa Aluminum Company of America
Motion Picture Section
1246 ALCOA Building
Pittsburgh, Pennsylvania 15219

Aluminum Association
750 Third Avenue
New York, N.Y. 10017

American Concrete Institute
Box 4754 Redford Station
22400 W. Seven Mile Road
Detroit, Michigan 48219
Motion Picture Films and Filmstrips on Concrete and Related Topics. 42pp. Free.

American Hardboard Association
20 North Wacker Drive
Chicago, Illinois 60606

American Institute of Timber Construction
333 West Hampden Avenue
Englewood, Colorado 80110

American Iron and Steel Institute
150 East Forty-Second Street
New York, N.Y. 10017

American Plywood Association
c/o Rarig Presentation Services
2100 North 45th Street
Seattle, Washington 98103

American Zinc Institute
212 Madison Avenue
New York, N.Y. 10017

American-Standard
Plumbing & Heating Division
40 West 40th Street
New York, N.Y. 10018

Architectural Aluminum Manufacturers Association
One E. Wacker Drive
Chicago, Illinois

Armstrong Cork Company
Flooring Craftsman Film
Lancaster, Pennsylvania 17604

Armstrong Paint & Varnish Works
Trade Sales Department
1330 South Kilborn Avenue
Chicago, Illinois 60623

Asphault Roofing Manufacturers Association
757 Third Avenue
New York, N.Y. 10017

Association Films, Inc.
Association Instructional Materials Division, 600 Madison Avenue
New York, N.Y. 10022

Audiovisual Instruction
Division of Continuing Education
Oregon State System of Higher Education, Gill Coliseum 133
Corvallis, Oregon 97331
Educational Film and Tapes 1970-71

Bailey Film Associates
11559 Santa Monica Boulevard
West Los Angeles, California 90025

Stanley Bomar Company, Inc.
Regional Office
1589 Chambers Drive
San Jose, California 95118

Bray Studios, Inc.
630 Ninth Avenue
New York, N.Y. 10036

Brett-Guard Company
162 Woodbine
Bergenfield, New Jersey 07621

Brooklyn Paint & Varnish Company
50 Jay Street
Brooklyn, New York 11201

Bruce Company
Ottawa, Kansas 66067

Bureau of Reclamation
Chief Engineer
Attention Code D-841, Bldg. 67
Denver Federal Center
Denver, Colorado 80225

Calaveras Cement Company
The Flintkote Company
315 Montgomery Street
San Francisco, California 94104

California Redwood Association
617 Montgomery Street
San Francisco, California 94111

Cenco Educational Aids
Regional Office
Santa Clara, California 95052

Colonial Films, Incorporated
752 Spring Street N.W.
Atlanta, Georgia 30308

Coordinator for Oregon, SW Washington Carpenters, Employers, and Apprentices Trust
Mr. Hilt Hoffman
Marquam Plaza
2522 S.W. 3rd Avenue
Portland, Oregon

Coronet Films
65 E. South Water Street
Chicago, Illinois 60601

DCA Educational Products, Inc.
4865 Stenton Avenue
Philadelphia, Pa. 19144

Delmar Publishers, Inc.
Mountainview Avenue
Albany, N.Y. 12205

DeVilbiss Company
300 Phillips Avenue
Toledo, Ohio 43601

Dow Chemical Company
Film Library; Audiovisual
2030 Abbott Road Center
Midland, Michigan 48640

E.I. Du Pont De Nemours & Company
Advertising Department
Refinish Section, N-2504
Wilmington, Delaware 19898

Dur-O-Wall National, Inc.
Mr. William L. Nichols
650 12th Avenue, S.W.
Cedar Rapids, Iowa 52406

Ealing Film Loops
2225 Massachusetts Avenue
Cambridge, Massachusetts 02140

DIRECTORY OF MEDIA PRODUCERS AND DISTRIBUTORS
(continued)

Educational Media, Inc.
106 West 4th Avenue
Ellensburg, Washington 98926

Encyclopaedia Britannica Educational Corporation
Regional Office
2494 Teagarden Street
San Leandro, California 94577

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, N.Y. 11435

E-Z Paintr Corporation
Mr. Sam Greco
4051 South Iowa Avenue
Milwaukee, Wisconsin 53207

Federation of Societies for Paint Technology
121 S. Broad Street
Philadelphia, Pennsylvania 19107

Fine Hardwoods Association
666 North Lake Shore Drive
Chicago, Illinois 60611

Franklin Glue Company
2020 Bruck
Columbia, Ohio 43207

GAF Corporation Reprographics Products
Audiovisual Order Department
Johnson City, N.Y. 13790

The Glidden Company
900 Union Commerce Building
Cleveland, Ohio 44115

Gypsum Association
201 North Wells Street
Chicago, Illinois 60606
Booklet: Publications and Visual Aids. 7 pages

Harcourt, Brace & Jovanovich
757 Third Avenue
New York, N.Y. 10017

Hardwood Plywood Manufacturers Association
PO Box 6246
Arlington, Virginia 22206

Ideal Cement Company
821 17th Street
Denver, Colorado 80202

Imperial International Learning
247 West Court Street
Kankakee, Illinois 60901

Inland Steel Company
30 West Monroe Street
Chicago, Illinois 60603

Insulation Board Institute
111 W. Washington Street
Chicago, Illinois 60602

Interchemical Corporation
150 Wagaraw Road
Hawthorne, New Jersey 07506

International Film Bureau
332 South Michigan Avenue
Chicago, Illinois 60604

Irwin Auger Bit Company
100 Grant Street
Wilmington, Ohio 45177

Key Productions, Incorporated
527 Madison Avenue
New York, N.Y. 10022

Lea Manufacturing Company
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Modern Talking Picture Service, Inc.
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Seattle, Washington 98103

Nasco West
Modesto, California 95352

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National Housing Center
1625 L Street, N.W.
Washington, D.C. 20036

National Association of Plumbing-Heating-Cooling Contractors
1612 S.W. Idaho
Portland, Oregon

National Forest Products Association
Technical Services Division
1619 Massachusetts, N.W.
Washington, D.C. 20036
Booklet: Lumber and Wood Products Literature. 32 pp. Free

National Information Center for Educational Media
University of Southern California
University Park
Los Angeles, California 90007
NICEM Index to 16mm Educational Films, 1971 Edition.
NICEM Index to 8mm Motion Cartridges, 1971 Edition.

National Paint, Varnish, and Lacquer Association
1500 Rhode Island Avenue, N.W.
Washington, D.C. 20005
Booklet, 15 pages, free

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Washington, D.C. 20005

National Ready-Mixed Concrete Association
Mr. V.P. Ahearn, Jr.
Assistant Managing Director
900 Spring Street
Silver Spring, Maryland 20910

National Safety Council
425 N. Michigan Avenue
Chicago, Illinois 60611

Oregon Apprenticeship & Training
Oregon Department of Labor
1400 S.W. 5th Avenue
Portland, Oregon

Pacific Productions
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Beaverton, Oregon 97005

Paint Industry Education Bureau
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Washington, D.C. 20005

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Regional Office
903 Seaboard Building
Seattle, Washington
16mm film catalog. Booklet, 8 pages, free.

Portland Public Schools
Instructional Materials Department
Audiovisual Section
Portland, Oregon
Audiovisual Materials Catalog, 1969-71

PPG Industries, Incorporated
Information Services Department
General Office, Attn: Manager
Audiovisual and Exhibits
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Louisville, Kentucky 40208

3M Company
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3M Center
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New York, N.Y. 10036

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Division Engineer
201 Custom House
Portland, Oregon 97209

U.S. Department of Agriculture
Office of Information
Photographic Division
Washington, D.C. 20250
Booklet, 10 pages, free. Color filmstrips and slide sets of the U.S. Department of Agriculture. Miscellaneous Publications No. 1107.

United States National Audiovisual Center
National Archive and Record Service
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Catalog, 165 pp., free. U.S. Government Films.

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Universal Education and Visual Arts
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Richmond, Virginia 23216

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New York, N.Y. 10014

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434 Mumford Hall
Urbana, Illinois 61801

Vocational Education Productions
California State Polytechnic College
San Luis Obispo, California 93401

Western Red Cedar Lumber Association
700 Yeon Building
Portland, Oregon 97204

Western Wood Products Association
700 Yeon Building
Portland, Oregon 97204

Westinghouse Learning Corporation
100 Park Avenue
New York, N.Y. 10017
Learning Directory, 1970-71, 7 volumes, 6681 pages.

Worcester Film Corporation
131 Central Street
Worcester, Massachusetts

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W.R. Grace and Company
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Chicago, Illinois 60654